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The Effects of Temperament on Mother-Infant Interactions

by

© K. S. Pain

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF Doctor of Philosophy

Educational Psychology

EDMONTON, ALBERTA

FALL, 1980

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

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Abstract

The inter-relationships between infant temperament and mother-infant interactions were explored using thirty mother-infant pairs. At infant ages of 3, 6, and 9 months, three major types of data were collected: Two 1-hour observations coded by trained observers on two different days, the Bayley Scales of Infant Development, and Carey's (1968) Survey of Infant Temperament Characteristics.

Results of the study indicated that the mothers involved were very 'child-oriented', spending 56 to 73% of their time involved with their infants. This involvement declined as the infants grew older, even though the amount of time together was relatively constant. Concurrent with this was a change in infant attention from mother to toys and play. A factor analysis resulted in 11 interpretable factors. The four strongest of these were labelled 'mother's positive attention to the child', 'child involvement with the mother', 'independent play vs. mother involvement', and 'easiness of temperament'.

Cross-lagged panel analyses were used to develop hypotheses as to the most likely agent of change in the mother-infant relationship. The most consistent trend appeared to be a tendency for a number of forms of maternal involvement and attention to increase infant activity over time. As well, there was some suggestion that mothers'

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positive expression to the infant at 3 months, and physical contact at 6 months might reduce withdrawal from new situations at 6 and 9 months, respectively. The only indication of child causation was that high intensity of reaction at 6 months might decrease maternal smiling, praise, etc. at 9 months of age.

Examination of the relationships of maternal ratings of infant activity with the other variables indicated that the activity ratings appear to have some validity at 6 and 9 months, but that at 3 months they are more related to maternal behaviours than to conceptually related measures.

A hierarchical cluster analysis of activity profiles suggested three profile groups: one with consistently high activity ratings, one with low ratings at three months, and higher ratings at 6 and 9 months, and one with a high, moderate, high pattern. Examination of maternal variables in light of these groupings indicated a slight tendency for mothers of the high-moderate-high group to behave differently than mothers of other infants, particularly at 6 months.

Finally, a set of exploratory factor analyses were computed to determine stability of factor structures across time. The clusters of variables indicating maternal involvement with the child and a central infant 'easiness' dimension comprised of the temperament traits of adaptability approach and mood appeared stable across time. Other infant behaviour and temperament variables appeared to

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be related more within age levels than across ages.

Results of the study are discussed in terms of their implications for Thomas, Chess, and Birch's (1968) theory of temperament, the study of separation anxiety, and the use of cross-lagged panel analysis in similar situations.

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I. Introduction

A. Effects of Children on Parents:

Traditionally, studies of the interactions between parents and children have focused on the effects of parents on the develpment of their children. In this context, many parental variables, (eg. education, background, behaviour, or attitude) have been investigated in a wide variety of situations to determine their effects on many different developmental outcomes. Recently, however, under the impetus of such writers as Bell (1968), Chess (1971) and Martin (1975), more and more research has focused on the opposite side of this question: the effects of children on parental behaviour. Indeed, Bell (1968) has demonstrated that much of the research originally used as evidence for the effects of parents on children could equally well be interpreted from a child-causation standpoint.

Research conducted to look at the effects of children on parents is founded on two basic premises: that children have some power to affect the relationship, and that children display continuing characteristics which can exert a more or less consistent influence on parental behaviour. For each of these premises there is both intuitive and research support. Even brief conversations with parents will elicit statements about individual differences among children, often with explicit acknowledgements of the effect on parental behaviour. "No, we can't come for the weekend,

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Mary can't seem to settle down to sleep in a strange place." "We're taking Peter to a concert tonight, he loves music." "We'll have to leave Paula at home, she can't sit still for that long." "Sally hates to give up when she's working on a puzzle." Statements such as these are familiar to every parent.

There is also research support for these two ideas. Bell (1968), Martin (1975), Sameroff and Chandler (1975) and Thomas et al. (1968) have all discussed the role of the child in determining the course of interactions between parents and children. Also, many authors have presented evidence for persistent individual differences in behaviour or temperament as early as the first year of life (eg. Thomas, Chess and Birch, 1968 and Kagan, 1974). These topics will be explored in more detail in the following chapter.

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B. Models of development:

Although there is support for the concept of child as well as parent influence in interactions, there is little to be gained by simply switching allegiance from a parent control model to one of child control. Both perspectives can be seen to be one-sided; they serve to simplifiy methodology, statistics and interpretations, but they represent an over-simplification of the phenomena studied. Sameroff (1975b) refers to this type of research as using a 'main effects' model, since it focuses on only one source of influence at a time. Perhaps the best-known of the issues

stemming from the use of this approach is the nature-nuture controversy in regard to the development of intelligence.

A more comprehensive model for use in predicting developmental outcomes is an interactive one, in which two sources of variation are taken into account. In the present context, this would involve the use of both parental behaviour and child characteristics in predicting outcomes. This model is somewhat more realistic for prediction and explanation, but once again it lacks flexibility and realism since it fails to take into account the changing nature of the relationship over time, and the mutual effects of the participants on one another. In other words, it is a static rather than a dynamic model of interactions.

In order to cope with continuing effects, a research model is required which looks at relationships across time. Sameroff has termed this a 'transactional' model. In the context of parent-child interactions, this model asserts that there is a continual interplay between parental behaviours and child characteristics such that one affects the other, which in turn affects the first, and that this has a cumulative effect on the interacton. Thus it focuses directly on the mutual interplay of forces, and on continual interaction over time. Using constitutional and environmental factors, Sameroff diagrammed this model as follows:

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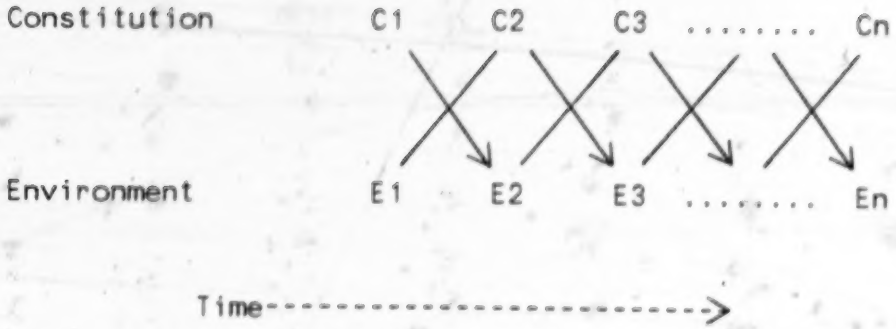

In attempting to explain the etiology of behaviour problems Thomas, Chess and Birch (1968) have applied this type of model in their statement that "the only continuity which is currently evident is the incapacity of certain environments to respond adaptively to particular infants with special needs." (Cited in Sameroff, 1975b, p283)

While the transactional model is theoretically appealing, particularly in its focus on 'process' rather than 'product', it creates some very real difficulties for research. Studies using this approach generate a number of data points across time, and both child and environment must be monitored. Once the data have been collected, a somewhat unique statistical approach must be taken in order to focus on the processes involved, and to cope with the sheer number of measures. Traditional analysis of variance and correlational approaches tend to be static and relate better to a main effects or an interactional model than a transactional one. The problem, then, is to develop alternative statistical methodologies in order to cope with the potential complexity of this type of data.

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Fortunately, some recently developed statistical techniques appear to hold promise for this type of research. These include, among others, path analyses (Wright, 1954), dependence analysis (Boudon, 1968) and cross-lagged panel analysis (Campbell, 1963). In particular, the latter has been used to trace the pattern of variable pairs across time, attempting to use the time element as a substitute for experimental control. Cross-lagged panel analysis thus facilitates the examination of variables measured across time, and permits one to make causal hypotheses from correlational studies.

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C. Purpose of the Study:

The present research was designed to explore the efficacy of the transactional model in the context of a study of mother-infant interactions. Specifically, it focuses on the mutual effects of infant temperament and maternal behaviour during the first 10 months of life. Very young infants were used in the study to minimize the effects of early learning, and also because the intensity and exclusiveness of the mother-infant interaction provides a more closed system than is available with older children. The concepts of temperament outlined by Thomas, Chess and Birch (1968) were used in order to take advantage of the breadth of writing in this area.

Specifically, this study was set up as an exploratory tool, examining three related issues in developmental

psychology. These include:

1. The documentation of the interaction between infant temperament and maternal behaviour over the first 10 months of life.
2. The exploration of the usefulness of cross-lagged panel analysis as a statistical tool for examination of interactions over time, and
3. An empirical examination of the temperament concepts proposed by Thomas, Chess and Birch (1968) in the context of infancy.

The rest of this paper will present a more detailed examination of the research in these areas, a description of the present research and statistical procedures, a presentation and discussion of the findings of the study, and finally a brief discussion of the implications of some of the results for other areas of research.

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II. Literature Review

A. Direction of Effects in Parent-child Research:

Traditionally, researchers in developmental psychology have interpreted parent-child interactions in terms of the effect of parents on their children. In order to interpret or predict child behaviour, the focus has been placed on the actions of the parents, particularly the mother. Chess (1964) has termed the tendency to see later deviance from accepted behaviour as a direct result of mothers' behaviour the 'mal de mere' approach. A number of recent reviews of the literature, however, have looked at the opposite side of the question: the effects of children on parental behaviour. In particular, Bell (1968), Chess (1971), Martin (1975), and Sameroff and Chandler (1975) have illustrated that, while researchers implicitly assign causality and control to the mother, many of the studies could equally well be interpreted from a child-causation standpoint.

Evidence of the effects of children on interactions is found from the first hours of life. The very helplessness and dependency of infants trigger the parents' desire to provide care (Harper, 1971; Reingold, 1966). Indeed, an infant's cry is such a potent stimulus for adults that, at one month of age, babies initiate approximately 80% of their interactions, more than later in life (Moss & Robson, 1968).

There is also a good deal of evidence that the pattern of infant-parent interaction is affected by individual

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differences in a number of infant behaviours, such as alertness and responsivity to stimuli, as well as by sex, and age. (Korner, 1971; Korner & Thoman, 1972; Lewis, 1972; Moss, 1967; Moss & Robson, 1969; Prechtl, 1963; Robson, 1967; Thoman, Leiderman & Olson, 1972). Also, infants who exhibit disturbed reactions such as loud or excessive fussing, who are difficult to soothe or exhibit late development of smiling or eye-to-eye contact can sometimes elicit negative reactions from their mothers (Bell, 1968; Brazelton, 1962; Robson and Moss, 1970). This can be linked directly to a reinforcement model: Mothers of infants with unpredictable or negative reactions receive little reinforcement for their efforts and may eventually show their frustration through negative acts.

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With older children, much of the evidence concerning child influence in the parent-child relationship comes from research into child abuse and neglect. Traditionally, causes for abuse have been sought in parental and societal characteristics. This approach, however, fails to account for two important facts:

a) not all parents with given characteristics abuse or neglect their children, and

b) not all children in a family are abused.

Clearly, other variables must also be included in an explanatory model.

There is an increasing body of evidence that interaction problems may be just as much a result of the

child's behaviour as the mother's. In Gil's (1970) sample, more than one half of the abused children showed some deviance in social, physical, or intellectual performance in the preceding year, and another one-quarter were reported as behaving in ways that were directly provoking. Klein and Stern (1971) found a significant correlation between battering and low birth weight, even when socio-economic status was controlled, and also, that many battered children with normal birth weight had other medical problems. These authors, as well as Klaus and Kennell (1970) suggest that infants with biological problems may overtax the resources of certain mothers, leading to an emotional crisis. Evidence of high numbers of difficult children involved in child abuse has also been reported by Elmer and Gregg (1967), Holter and Friedman (1968) and Milowe (Cited in Gil, 1970). McKay and McDoug (both cited in Milowe and Lourie, 1964) found that the same children are sometimes battered by a number of caretakers, again indicating that the children themselves may act in ways which somehow precipitate abuse. There is also a tendency for parents of abused children to describe these children as difficult or unmanageable (Morse, Sahler & Friedman, 1970).

A similar pattern of child contribution has been hypothesized in studies of child neglect (Gil, 1970). Leonard, Rhymes & Solnit (1966) grouped 'failure-to-thrive' children and their mothers into two personality patterns:

a) active, irritable, difficult to comfort

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children with tense, high-strung and aggressive mothers, and

b) passive, quiet children with passive, quiet, depressed mothers who make little contact with their undemanding children.

Many children who fail to thrive are described as difficult or irritable, with irritating cries. Even in hospital, they are seen by nurses to be unappealing and tend to be placed in beds far from the nursing station (Milowe and Lourie, 1964).

Thus, studies on abuse and neglect of children tend to support the concept of child influence on the patterns of interaction between parents and children. The problem is that all of these are retrospective studies, gathering data after the fact, and making it impossible to draw inferences as to cause and effect. To try to eliminate this problem, Thomas, Chess and Birch (1968) used an anterospective design in which data were collected systematically over a number of years, then analyzed to determine the precursers of behaviour problems. Their results indicated that approximately 10% of the sample could be categorized as 'difficult', and that 25% of the children later manifesting behaviour problems came from this group. The critical variable in terms of outcome appeared to be the attitude of the parents and their ability to cope with these behaviour patterns.

One hypothesis as to the origin of maternal behaviour

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has been put forward by Bell (1974). He has proposed that a homeostatic tendency exists for parents such that they react to bring children's behaviour towards some imagined norm. They therefore react to perceived deviance in frequency or intensity of behaviour by attempting to reduce excesses in 'hyper' children or by trying to stimulate behaviour in children perceived as lethargic or unreactive. In support of this hypothesis, Escalona (1968) has demonstrated that maternal play reactions are such that drowsy infants are stimulated and agitated infants are calmed and soothed.

All of this evidence strongly suggests that children, as well as parents are influential in determining the course of development and interaction, and that attempts to understand and predict behaviour patterns must examine both sides of the interaction in order to be effective. Unfortunately, this adds substantially to the complexity of research designs, particularly when there is a dearth of relevant theory to guide investigations, and when it is difficult, if not impossible to get adequate experimental tests of hypotheses. The study of interaction patterns is further complicated by the likelihood that causal patterns shift with time, and react differently for different variables. In spite of this research difficulty, looking at the direction of effects in interactions seems important, particularly when planning therapeutic interventions or predicting later needs.

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B. Theories of temperament:

The research summarized above indicates that individual differences in children and infants do indeed have some impact on parental behaviour. In studies of parent-child interactions, a very wide variety of child variables have been used to examine these relationships. (See, for example, Escalona, 1968; Kagan & Moss, 1962; Korner, 1971; or Mussen, 1960.) Unfortunately, while many of the variables used by these authors have approximate equivalents in other studies, rarely has any one categorization received extensive use by a number of authors. Generally, researchers in this area appear to conceive of their task as involving the investigation of particular variables perceived to be important rather than as the formulation of a theory covering a dimension of behaviour.

One exception to this has been the study of 'temperament'. In this domain, a number of authors have attempted to provide an exhaustive description of the possible behaviours. Temperament, as used by these authors, refers to the 'how' of behaviour; not content but style. It is often conceived as being hereditary rather than learned (Buss and Plomin, 1975). Allport has defined temperament as follows:

> Temperament refers to the characteristic phenomena of an individual's nature, including his susceptibility to emotional stimulation, his customary strength and speed of response, the quality of his prevailing mood, and all the peculiarities of fluctuation and intensity of mood, these being phenomena regarded as dependent on constitutional make-up, and therefore largely

hereditary in origin. (1961, p.34).

One of the most widely used theories of temperament is that developed by the psychiatrists Thomas, Chess, Birch, Hertzig and Korn (1963). Realizing that behaviour problems could not be adequately predicted or described using conventional psychodynamics, these authors set out to trace the development of children in a systematic fashion, starting in infancy. From observations and interviews with an initial sample, they hypothesized that it was behavioural style or temperament which had the most impact on future development. Through extensive interviews with parents, they then proceeded to develop a system of nine categories characterizing the style of children's behaviour. These could be identified as early as 2 to 3 months of age and were also evident in older children. The nine categories and their descriptions are as follows:

> 1. Activity level: the motor component present in a given child's functioning and the diurnal proportion of active and inactive periods. Protocol data on the child's motility when he is being bathed, fed, dressed, and handled, as well as information concerning his sleep-wake cycle and his reaching, crawling, walking, and play patterns are used in scoring this functional category.
>
> 2. Rhythmicity (biological regularity): the predictability and rhythmicity and/or the unpredictability and arrhythmicity in time of any function. This is analyzed in relation to the child's sleep-wake cycle, his hunger or feeding patterns, and his elimination schedule.
>
> 3. Approach-withdrawal (positive-negative initial responses): the nature of the child's initial response to a new or altered stimulus, be it a new food, a new toy, or a new person.

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4. Adaptability: the nature of a child's resonses to new or altered situations with respect to the ease with which they are modified in a desired direction, irrespective of the initial response.

5. Intensity of reaction: the energy level or vigor of a child's response, independent of its direction (either a negative or a positive reaction can be mild or intense). Responses to stimuli, to pre-elimination tension, to hunger, to repletion, to new foods, to attempts at control, to restraint, to dressing, and to diapering, all provide scorable items for this category.

6. Threshold of responsiveness: the intensity level of stimulation that is necessary to evoke a discernable response, without regard to the specific form that the response may take or the sensory modality affected. The behaviors used are responses to (a) sensory stimuli (b) environmental objects, and (c) social contacts.

7. Quality of mood: the amount of pleased, joyful, and friendly versus the amount of displeased, crying, and unfriendly behavior is determined; i.e., does the child show more smiling and laughing or more fussing and crying behavior?

8. Distractibility: the ease with which a child can be diverted from an ongoing activity by extraneous peripheral stimuli.

9. Attention span and persistence: these two categories are related. Attention span is the length of time a particular activity is pursued by the child. Persistence refers to the continuation of an activity by the child in the face of obstacles to the maintenance of the activity direction.(Chess & Thomas, 1973, p.86)

(N.B. These category names will be shortened to activity, rhythmicity, approach, adaptability, intensity, threshold, mood, distractibility, and persistence in the remainder of the paper.) Subsequent longitudinal research with these scales incorporated interviews with parents every three to six months for 5 years, and yearly interviews thereafter. These, along with school interviews and other assessments

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have yielded a great deal of information on various aspects of temperament and its interactions with the environment. (There are a large number of reports based on this New York Longitudinal Study. See, for example, Birch, Thomas & Chess, 1964; Chess & Thomas, 1973; Rutter, Birch, Thomas & Chess, 1964; and Thomas, Chess & Birch, 1968.)

One of the major questions in the study of temperament involves the stability of the traits across time. In order to determine this, the longitudinal data from the New York Longitudinal study has been analyzed for intra-individual consistency across time. Results generally indicate moderate stability from year to year with more change for longer terms. Activity, adaptability, and rhythmicity were the most consistent, overall, with approach, distractability and persistence the least stable, especially early in life. In addition, Wilhoit's (1976) research with 3 to 9 month old infants indicates that even at these ages there is stability in the ranking of the traits, particularly for girls.

One of the problems with the temperament categories proposed by Thomas et al. (1963) is the fact that the categories are overlapping. (A child who is always high on approach cannot be rated as slow to adapt, for example.) Various attempts have been made to group the traits into a smaller number of independent clusters. In the original research, Thomas et al. identified three clusters of behaviours from a qualitative analysis of the material. They postulated that children could often be categorized as

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'easy', 'difficult', or 'slow-to-warm-up'. Easiness and difficulty represent opposite poles of a continuum defined by high or low levels of the traits of rhythmicity, approach, adaptability, mood and intensity. The easy child adapts quickly and easily to new situations, is usually pleasant and cheerful, and has regular biological functions. The difficult child, on the other hand, has intense, often negative reactions to new experiences, adapts slowly, and tends to be irregular in biological activities like sleeping and eating. The slow-to-warm-up child, on the other hand, is one who characteristically quietly withdraws from new situations, and requires a lengthy time to adapt, but who does eventually come to function in new situations. In specific terms, this type of child has low ratings in intensity, mood, approach and adaptability. Although these clusters are intuitively appealing, they are not confirmed by factor analysis.

The clusters found by Thomas et al. using factor analysis differed considerably from the qualitative ones. Factor A was indeed similar to the 'easiness' cluster, and involved high approach, mood, and adaptability with low intensity, but rhythmicity was not included, even though it was in the original definition. This factor was essentially the same for all ages (1 to 5 years). Factor B was somewhat less stable across age, but generally included high adaptability, rhythmicity and threshold with low intensity and activity. This seems in a sense to be a 'reactivity'

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factor. Factor C was much less consistent, and appears to have a different meaning depending on the age of the children. Limited support for part of this factor structure is found in Scholom's (1975) research with three and four year olds. Using Carey's (1973) Survey of Infant Temperament, he extracted three factors. The first of these included the traits of approach, adaptability, mood and threshold, and was labelled 'mood'. This is comparable to the original Factor A, except for the substitution of threshold for intensity. Also, Scholom's third factor, labelled 'energy level' was somewhat similar to Factor C for children of this particular age group. His second factor, labelled 'consistency', does not correspond to any of the original factors.

One of the central tenants of the temperament theory put forth by Thomas, Chess, and Birch is the need to consider the interaction between temperament and parent behaviour in predicting or explaining developmental outcomes. They have postulated that parents need to adapt to the individual characteristics of their children for successful outcomes, and have interpreted a large number of case studies in these terms. Two recent studies have examined parental responses to different temperament types in a more controlled setting. Campbell (1979) found a negative relationship between ratings of rhythmicity for three month olds and mother's time engaged in play and responsiveness to cries. When comparing 'difficult' infants

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with matched controls, she also found significant differences between maternal vocalization, responsiveness and time involved. These differences in maternal behaviour were also found at eight months of age, even though most of the temperament ratings were then no longer different for the two samples. In contrast to these findings, Sarett (1976) reported that difficult infants at 14 weeks of age received five times as many soothing behaviours from their mothers than other babies. One difference between the two studies which may help to account for the discrepant results is that the Campbell observations were done only when the infants were "awake, alert and not hungry", reducing the number of fret/cry episodes, whereas the Sarett data are based entirely on comforting situations.

In spite of its lack of empirical support the temperament theory proposed by Thomas et al. has received wide use by the psychological and psychiatric community. Also, even though they do not stand up in factor analysis, the nine temperament categories appear to have been found useful in practice. It is imperative, however, that more systematic research be done to validate the theory empirically by further investigating hypothesized relationships and outcomes.

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C. Cross-lagged panel analysis:

One possible means of studying bi-directional causal relations in interactions is to examine the variables across time. Since a variable measured at a later time cannot directly effect a variable measured earlier, many of the possible causal links are eliminated, simplifying and giving structure to the analysis. Several methods of using time-lagged measurements to investigate causal relationships have been proposed, and have been used extensively in economics and sociology. One of the most commonly used techniques, cross-lagged panel analysis, was developed by Campbell (1963) and others from the preliminary work of Lazarsfeld (1944) and Simon (1954).

Briefly, the rationale for this type of analysis is based on the idea that, if one event or variable (which we will call B) consistently follows another event or variable (here called A), only two explanations are possible: either A causes B, or A and B are both the result of some third event or variable, X. In experimental research, A can be directly manipulated to determine its effect on B, thereby evaluating the two hypotheses. In many areas, however, this direct control of A is impossible. In such situations, the element of time of occurrence is used to approximate the experimental situation. If A at Time 1 consistently precedes B at time 2 (represented by a high cross-lagged correlation), but B at Time 1 less consistently precedes A (a lower correlation), then this can be taken as an

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indication that the preponderant causal direction is from A to B rather than vice versa.

Take, for example, the data reported by Crano (1977) relating infants' scores on the California First year mental scale and a behavioural measure of speed of movement. Both variables were measured at 10-12 months and at 13-15 months of age. The relationship between the two measured contiguously is fairly constant (r=.32 and .36, respectively). Also, the test-retest correlations indicate stability of the two traits over the time period involved (r=.81 and .75, respectively). The core of the analysis comes in the comparison of the two cross-lagged correlations. Here, the early measure of mental ability often appears to precede the later indication of speed of movement (r=.47), but there is much less relationship between early speed and later mental score (r=.20). From this pattern of results, Crano concluded that the most likely hypothesis is that early mental ability effects later speed of movement, rather than vice versa.

In regard to cross-lagged panel analysis, Rozelle and Campbell (1969) have pointed out that there are really four competing hypotheses, rather than the two usually considered. The two possibilities which have been most often examined can be termed congruent conditions: either high levels of A lead to high levels of B or high B leads to high A. There are, however, also two incongruent hypotheses: that high levels of A lead to low levels of B or that high B

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results in low A. In order to be able to examine all four possibilities, Rozelle and Campbell suggest the use of a 'no-cause' comparison, which provides a baseline against which the correlations can be judged as increasing or decreasing. Specifically they use the mean of the two contiguous correlations attenuated by the internal reliabilities of the variables.

Cross-lagged panel analysis has been applied in a number of areas in developmental research (Crano, 1977; Crano, Kenny & Campbell, 1972; Crano & Mellon, 1978; Eron, Huesmann, Lefkowitz & Walder, 1972). In a similar context to the one here, Clarke-Stewart (1973) used the technique in her study of mother-infant interactions. She examined the relationships between mothers' attentiveness and responsiveness to the child, the child's Bayley mental test score, and expressions of emotion by the pair. Generally, the most plausible hypotheses from her data were that the mother's attention and behaviour affected the infants mental test score, and that the child's looking, smiling and vocalizing to the mother made her more responsive and led to her spending more time in the same room. Thus, her data indicate that causality in this type of interactive system can be assessed, but that it changes depending on the variables involved. Unfortunately, although she obtained measures on the variables at three time periods, Clarke-Stewart used only two times in most analyses, so the stability of these relationships cannot generally be

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determined. The one analysis which was conducted over three time periods indicated that maternal attention led to increased attachment behaviour by the child at time 2 (14 mos.) but that it was the amount of attachment behaviour by the child at 14 mos. which determined attention at 17 mos.

The above information indicates that the direction of causality or control in parent-child relations varies, and characteristics of both parents and children must be taken into account in attempting to understand interactions. Sameroff (1975) refers to this as a transactional model of development. In his view, "the constants in development are not some set of traits but rather the processes by which these traits are maintained in the transactions between organism and environment" (p. 281). Using this framework, it seems necessary to first identify variables affecting and affected by the interactional transactions, and then to trace the relationships among these. The use of time-lagged measures of these variables then appears to permit examination of these in order to make possible causal interpretations of the data.

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III. Methodology

In order to investigate mother-infant interactions over time, a longitudinal study was conducted, with information collected when the infants were 3, 6, and 9 months of age. The three major data sources were: observations and ratings of the behaviour of the mother-infant pairs, a questionnaire assessment of infant temperament, and a standardized test of developmental level. The mean age of the infants at time 1 (T1) was 3 months, 9 days, at time 2 (T2), 6 months 12 days, and at time 3 (T3), 9 months, 17 days. Testing was done 1 to 2 weeks following the first observation session. (See Table 1 for ages and intervals between sessions.)

The sections below provide a more detailed description of the subject recruitment procedure, the observation methodology, the temperament questionnaire, and the ability assessments.

A. Subjects

Thirty-four mother-infant pairs were recruited through the Edmonton Childbirth Association (n=17), newspaper birth announcements (n=14) and referrals from other subjects and acquaintances (n=3, total n=34). All babies were first born, healthy, term infants whose mothers were not planning to return immediately to full-time employment. Half were girls and half boys. Of the mothers contacted, only four who fit

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Table 1

Age of infants at observation and testing sessions. (Figures indicate months:days.)

	T1		T2		T3	
Session	Mean	S.D.	Mean	S.D.	Mean	S.D.
Observation 1	3:09	0:6	6:12	0:8	9:17	0:9
Observation 2	3:14	0:2	6:16	0:3	9:23	0:4
Bayley Test	3:22	0:7	6:24	0:6	9:29	0:9

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the selection criteria refused to participate: two were moving at the time of the first observation, one had a baby who was extremely colicky, and one gave no explicit reason. Over the course of the study, four mother-infant pairs were lost: three families moved out of the province before the 6 month observation session, (T2: n=31; 15 girls, 16 boys), and one was on an extended holiday at nine months (T3: n=30; 14 girls, 16 boys). Unless otherwise indicated, the analyses below are based on this final sample of 30 mother-infant pairs for whom complete data are available.

At the end of the last observation session, mothers were asked for information regarding previous experience with infants, and some general demographic information. Questionnaires used to gather this information are included in Appendix C.

B. Observations and Rating Scales

During each of the data collection phases, the mother-infant pairs were observed for two sessions of approximately one hour each. Visits were timed to coincide with an awake period for the baby, generally around a feeding. In order to make the mother's reactions as normal as possible, the research was explained as a study of the various stimuli that impinge on an infant in the course of everyday activities. Stress was placed on the observation of the infant rather than the mother, and this impression was strengthened by the fact that the observer stayed with the baby when the mother moved into a different room. The same observer was used for all three sessions to help mothers become as familiar and comfortable with her as possible. Three observers collected this portion of the data; all were female, caucasion, and themselves mothers of young children. One was a graduate student in Family Studies (observed 12 pairs), one was an Education student (12 pairs), and the last was the author (10 pairs).

To code the interaction, observers used a revised version of the PACIC code developed by Lytton (Undated). This 5-place code enabled observers to note the setting, subject, action, object and modifiers for activities of the mother and the infant. A fixed interval time-sampling technique was used: every 20 seconds the observer responded to a beep from an earphone by coding all infant activities, as well as the mother's activities vis-a-vis the infant, if

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she was present. One of these records, for example, might read, 'Child sits in high chair in kitchen with mother present and radio on, mother does housework, mother looks at child, child looks at toy, child holds toy and child plays with toy energetically (Or, in code, Z26M2, M50, M21C, C21T, C01T, C11T4).

The observer coded behaviour for 14 minutes (42 records), then completed a rating scale, developed by Clark-Stewart (1973), and wrote a brief summary of the activities which had occurred during that session. (See Appendix A for a copy of the observation codes and rating scales.) Observations were terminated after four 14 minute sessions or when the baby fell asleep. At least one hour of observation was coded for each mother-infant pair at each age level.

From the original codes, a number of super-ordinate variables were derived, and these are described in Table 2. It should be noted that each super-ordinate category was counted only once per coding record, even though several actions fitting into a given category may have been coded simultaneously. To equate the measures for the different amounts of observation time for various subjects, each measure is expressed as a ratio of times occurring over the total number of observation records.

Two additional indices, termed mother and child responsiveness, were derived from the data. Maternal responsiveness (M. Resp.) was calculated by counting the

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Table 2

Super-ordinate observation categories and descriptions.

Abbreviation	Description
I. Maternal Variables:	
1. M. Inv. C.	Mother's involvement with the child. This includes all actions directed by the mother toward the child.
2. M. Smiles C.	Mother smiles or otherwise shows positive emotion to the infant by the use of praise or gentle, comforting or loving actions.
3. M. Looks C.	Mother looks at the child.
4. M. Voc.	Total vocalizations by the mother, regardless of object.
5. M. Voc. C.	Mother's vocalizations which are directed toward the child.
6. M. Rest. C.	Mother restrains, reprimands or punishes child.
7. Caretaking	Mother feeds, changes, dresses, or washes child.
8. M.-C. Contact	Physical contact between the mother and child which is initiated by the mother.
II. Child Variables:	
1. C. Inv. M.	Child involvement with the mother. This includes all actions directed by the child toward the mother.
2. C. Smiles M.	Child smiles at the mother.
3. C. Looks M.	Child looks toward the mother.
4. C. Fusses	Predominantly infant fusses or mild cries , but also includes isolated incidents of loud crying and non compliance (such as turning the head away to refuse food).
5. C. Toy Inv.	Includes all instances of infant involvement with toys or objects.
6. Gross Motor P.	Gross motor play includes large limb movements, walking, or crawling.
7. Fine Motor P.	Fine motor play refers to instances of touching, holding and manipul ating objects with the hands.

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Table 2 (cont'd)

Super-ordinate observation categories and descriptions.

Abbreviation	Description
II. Child Variables (cont'd):	
8. C.-M. Contact	Physical contact between the child and mother which is initiated by the child. If the child is being held by the mother but is passive, it is not counted here.
9. C. Voc.	Includes all vocalizations by the child regardless of object, except those that are clearly cries or frets.
10. C. Voc. M.	Child vocalizations when the mother is present.
III. Mutual and Setting Variables:	
1. Mut. Looking	Both mother and child looking toward each other during the same record (not necessarily eye-to-eye).
2. C. Unconst.	Proportion of time the infant is out of constraining devices (such as infant seats, high chairs, etc., and is not being held.
3. M. & C. Tog.	Mother and child in the same room, or where visual contact is possible.
4. Bkgnd. Noise	The number of records during which radio, stereo or T.V. was playing during the observation.

number of 20 second periods in which the child was coded as fussing before some maternal response was made. The corollary, child responsiveness (C. Resp.) was then the number of records in which fussing continued to be coded after this intervention. Fussing was considered terminated when it was not coded during three consecutive records (1 minute).

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Table 3

Interobserver reliabilities for the superordinate categories used in data analysis. Percentages represent the number of pairwise agreements divided by the number of categories coded by either of the observer pair.

Variable Type	Time 1	Time 2	Time 3
Child Codes	61.2	71.6	77.1
Mother Codes	85.0	78.9	75.8
Setting Codes	100.0	100.0	99.4
Minutes Coded	14	14	19

Videotapes of mothers and infants of appropriate ages were used to train observers and calculate inter-observer reliabilities. Table 3 presents the pairwise percentage agreement for the superordinate categories used in the data analysis. Agreement ranged from 61.2 to 100%, with a mean over all data types and times of 84.6%. This likely represents a conservative estimate of the reliability since the videotapes used were of marginal quality, leading to coding errors unrelated to understanding and use of the coding scheme. Inter-observer reliability for the rating scales was also determined using the video-tapes. Agreement here was counted when the ratings were within one scale point. Mean pair-wise agreements for the three sessions were, respectively, 79.7%, 88.4%, and 91.3%, with a total range of 73.9% to 95.7%.

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C. Temperament questionnaire

Infant temperament was assessed through the use of Carey's (1973) 'Survey of Infant Temperament Characteristics'. This questionnaire consists of 70 items concerning a variety of aspects of infant experience. It yields weighted mean scores ranging between 0 (high trait level) and 2 (low trait level) on the nine temperament traits delineated by Thomas, Chess and Birch (1968). These traits include: activity level, rhythmicity, adaptability, approach, threshold, intensity, mood, distractability, and persistence. Definitions and examples of these traits are given in Chapter 2.

With his initial sample of infants, Carey reported means and standard deviations very close to those which Thomas et al. (1968) determined using extensive interviews. As well, Wilhoit (1976) reported adequate test-retest reliabilities for the scales, and results which are close to those determined using interviews in terms of rank ordering of temperament traits. For eight month olds, Campbell (1979) reported two week test-retest reliabilities for the scale ranging from .55 to .78, with a mean of .67.

Pretesting of the questionnaire with mothers of young infants indicated some problems necessitating additional instructions for the subjects. Specifically, mothers were instructed to omit items when the situation referred to had never occurred, (such as illness), and those who were exclusively breast-feeding and had no concrete measure of

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amount of milk taken during a feeding were asked to estimate this from feeding time if possible, or to omit this item.

D. Bayley Scales of Infant Development

Infant developmental level was determined through the administration of the Bayley Scales of Development, given one to two weeks following the observations. The Bayley consists of three subtests: the Mental Scale which was designed to assess memory, learning, object constancy, problem solving, and early language skills; the Motor or Performance Scale which examines fine and large motor control and coordination; and the Infant Behavior Record which is intended to help the clinician to assess and describe the child's orientation toward his/her environment in general and the test situation in particular. Published split half reliabilities for the Bayley scales range from .81 to .93 on the Mental Scale, and from .78 to .84 on the Motor Scale for the 3 to 10 month age range.

The Bayley scales were administered by the author (n= 13), and another graduate student in Educational Psychology (n=21). Testing procedures were taken directly from the manual, with ambiguities clarified by an experienced tester. To avoid systematic bias from the two situations, the Bayley scales were never administered by the person who had previously done the behavioural observations. Reliability for the three sessions was determined by having each tester administer the test to a non-sample baby of appropriate age

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Table 4
Mean reliabilities for the administration of the Bayley Scales of Infant Development. (Figures indicate percentage agreement for the items scored by both testers on the two administrations.)

	Age when Tested:		
	3 Mos.	6 Mos.	9 Mos.
Mental Scale	94.2	94.0	90.8
Performance Scale	92.1	90.6	96.2
Behavioural Inventory	81.7	83.4	86.7

while the other watched and scored the items. Reliabilities ranged from 84% to 98% on the Mental Scale, and from 85% to 100% on the Performance Scale for the three ages. On the Behavioural Inventory, answers were considered in agreement if they were within one scale point, except for dichotomous items where absolute agreement was required. Reliabilities on this scale ranged from 77% to 97%. (See Table 4.)

E. Statistical Analysis

Data from the study were analyzed in a number of different ways. The results of the Bayley Scales of Development, the Carey temperament ratings, and the behavioural observations were examined independently for stability across time, sex differences, and intercorrelations. Factor analysis was then applied to the data to examine the inter-relationships among the variables.

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Cross-lagged panel analysis was used to look at the relationships between the temperament ratings and the maternal behaviour variables. In this context, all possible pairs of variables were examined, looking for significant differences between the cross-lagged correlations. When these differences were found, the pattern of correlations across time was examined to determine the most likely hypothesis as to preponderant causal direction.

A number of exploratory analyses were also carried out, in order to provide a clearer picture of the patterns of relationships among the variables derived from the planned analyses. These included a more detailed examination of correlations of rated activity with other variables, a cluster analyses of the infants activity profiles, and examination of various maternal behaviours in light of these profile groups. Finally, a number of factor analyses were computed, looking at stability of relationships across time.

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IV. Results

Results of the study will be presented in several sections, including a description of the sample, general results from the Bayley Scales of Infant Development, analysis of the temperament questionnaire information, findings from the observations and rating scales, and, finally, inter-relationships among the various measures.

A. Description of the Sample

Thirty mother-infant pairs were included in all three phases of the study: these form the core sample upon which most of the following results are based. Four pairs moved or went on holiday during the course of the study, and these are included in the data only where explicitly noted. Families came from all Socio-economic levels, although they tended to be middle- to upper-middle class, with high levels of education. Of the mothers included, 13 (43%) had 13 to 16 years of education, and 7 (23%) had more than 16 years. For the fathers, the figures are even more extreme, with 8 (27%) having 13 to 16 years of education, and 14 (47%) with more than 16 years.

Following the last observation, mothers were questioned by the observers as to the amount of previous experience they had had with infants, and the amount of reading they had done concerning child care and development. Almost all

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mothers (93%) had done at least some reading in this area, and 90% had one or more books on the subject in their homes. Slightly more than half (53%) reported some or extensive prior experience with infants. (See Appendix C for a copy of the questionnaire used and a more complete description of results.)

One unusual characteristic of the sample of mothers in this study, as compared to the population as a whole, is the extent of breastfeeding. Almost all of these mothers (93%) nursed their infants for some time after birth, with 60% still breast-feeding at 3 months, 53% breast-feeding at 6 months, and 37% delaying weaning until 9 months or later.

Therefore, this sample must be described as relatively privileged in terms of education and income levels, and as child-oriented in terms of interest and behaviour patterns. For these reasons, care must be taken in generalizing the results from this study to other groups.

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B. The Bayley Scales of Infant Development:

Means, standard deviations and ranges of the Mental and Performance scales are presented in Table 5. Scores fall in the normal to superior ranges, with means somewhat above the average of the standardization sample.

In order to test for sex and age differences two-way repeated measures analyses of variance were carried out on the Mental and Performance subscale scores. There were no significant sex effects for either subtest, nor was there a

Table 5

Means, standard deviations and ranges of scores on the Bayley Scales of Infant Development.

	Mental Scale			Performance Scale		
	Mean	S.D.	Range	Mean	S.D.	Range
3 Months (n=33)	109.6	13.2	86-137	114.5	12.1	90-138
6 Months (n=31)	105.2	13.6	83-132	115.2	11.1	95-144
9 Months (n=30)	106.7	17.4	79-143	106.2	10.1	84-124

significant time effect for the Mental Scale scores. There was, however, a significant decline in the Performance Scale developmental quotient after 6 months, bringing the 9 month mean closer to that of the standardization group mean. (Scheffe critical difference = 8.20, $p<.01$). There is no apparent reason for this difference in means at 9 months. (The analysis of variance results are presented in Table 6.)

Correlations of the Bayley Scale scores across time are presented in Table 7. Mental Scale scores were significantly correlated between 3 and 9 and between 6 and 9 months of age, but not between 3 and 6 months. Performance scores were correlated between 3 and 6 and 6 and 9 months, but not on the longer term. These correlation patterns are similar to those found in other research (See Lewis, 1976), with the exception of the 3 to 6 month correlation for the mental scale, which is somewhat lower than most others reported.

It should be noted that the mean squares for the Time

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Table 6

Summary of Analysis of Variance results testing effects of sex and time on the Bayley Mental and Performance sub-test scores.

Source	SS	df	MS	F
I. Mental Scale Scores:				
Between Subjects	10930.00	28		
Sex Effect	333.10	1	333.10	0.85
Subjects within gps.	10597.44	27	392.50	
Within subjects	7971.38	58		
Time effect	104.10	2	52.05	0.38
Sex x Time Int.	486.08	2	243.04	1.78
Time x subjects within groups	7366.81	54	136.42	
II. Performance Scale Scores:				
Between Subjects	5890.00	28		
Sex Effect	46.16	1	46.16	0.21
Subjects within gps..	5843.00	27	216.41	
Within subjects	6514.00	58		
Time effect	1253.66	2	626.83	6.51**
Sex x Time Int.	44.35	2	22.18	0.23
Time x subjects within groups	5201.00	54	96.32	

**p<.01

by Subjects within groups term in the repeated measures anova results (Table 6) is relatively high, both for the Mental and the Performance subscale scores. This term incorporates two confounded sources of variance: that due to test error, and that due to trait shifts over time. In order to determine the degree of shift over time, an estimate of the test error is needed. This is provided by the published standard error terms for the various ages. (Unfortunately, these standard error terms are based on split-half

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Table 7

Correlations of the Bayley Scaled Scores over time.

		Mental Scale			Performance Scale		
		T1	T2	T3	T1	T2	T3
Mental Scale	T1	1.00					
	T2	.09	1.00				
	T3	.38***	.62***	1.00			
Performance Scale	T1	.46**	-.04	.38*	1.00		
	T2	.32	.24	.51**	.44*	1.00	
	T3	.34	.24	.40*	.03	.38*	1.00

*p<.05 **p<.01 ***p<.001

reliability coefficients, and thus may be artificially low. However, since there are no other error estimates available, these will be used as an estimate the amount of variance from the two sources.) For the Mental subscale scores, the average test error variance for the 3, 6, and 10 month old samples was 28.65 (S.E.=4.2, 4.7, and 6.8, respectively). Obviously, the Time by Subjects within group variance of 136.42 is considerably larger than this, indicating that a large portion of this term is attributable to lack of stability of the Mental Scale quotients for these infants over time. The figures for the Performance Scale scores lead to a similar conclusion. Here the average test error is 41.70 (S.E.=7.5, 5.4, and 6.3 at 3, 6, and 10 months, respectivly), and the overall variance is 96.32. Again, this would indicate a high level of trait instability. An examination of the correlations in Table 7 indicates that the major change may be occurring between 3 and 6 months for

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the Mental Scale scores and between 3 and 9 months for the Performance Scale scores.

C. The Carey Survey of Infant Temperament

The mean temperament ratings from each of the three testing times, and the average across all times are presented in Table 8. From these it can be seen that the babies in the study, as rated by their mothers, are active, rhythmic in functioning, and very adaptable. They approach rather than withdraw from new situations, have moderate to low sensory thresholds, and react with moderate intensity. They are predominantly positive in mood, fairly distractable (less so at 3 than at 6 or 9 months), but are persistent in persuing their desires. Note that a high score on the Carey scales indicates a low level of the trait. All scores range from 0.0 (very high) to 2.0 (very low).

Hotelling's T-Square statistic was used to compare the means across time, and to compare the overall means with those found by Carey. In the across time tests, the three month set of scores was found to be significantly different from both the six and the nine month scores (T-Sq.=6.59 and 8.76 respectively, df=9,21, $p<.001$). Post hoc analyses indicated that this difference was due to a mean distractability rating that was significantly lower at three months than those at 6 or 9 months of age. There was no significant difference between the 6 and 9 month sets of means. (T-Sq.=1.38, df=9,21, N.S.)

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Table 8

Mean temperament scores for each age, mean averaged over all three ages, and means reported by Carey (1973).

	T1 (n=34)	T2 (n=31)	T3 (n=30)	T1-T3 (n=95)	Carey
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Means
Activity	.50 (.26)	.35 (.23)	.34 (.25)	.40 (.18)	.52
Rhythmicity	.76 (.45)	.61 (.39)	.55 (.39)	.66 (.32)	.53
Adaptability	.35 (.27)	.38 (.28)	.42 (.31)	.39 (.23)	.35
Approach	.68 (.42)	.53 (.34)	.61 (.37)	.61 (.32)	.48
Threshold	1.11 (.36)	1.14 (.31)	1.08 (.31)	1.11 (.24)	1.08
Intensity	1.02 (.26)	.98 (.28)	1.04 (.27)	1.03 (.22)	1.05
Mood	.46 (.19)	.48 (.20)	.50 (.22)	.49 (.16)	.40
Distract'ty	.73 (.31)	.44 (.32)	.39 (.31)	.53 (.24)	.57
Persistence	.68 (.42)	.86 (.24)	.92 (.41)	.82 (.24)	.69

In the comparison between the overall means from this study (T1-T3) and those found by Carey, with his 4 to 8 month olds, the results were found to be marginally different (T-Sq.=29.77, f=9,21, p=.054). However, none of the individual pairs of means was significantly different with post-hoc tests.

One of the most common ideas held by parents is that there is an innate difference between boys and girls in various temperament traits, particularly activity level. To

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Table 9

Mean temperament scores for boys and girls at 3, 6, and 9 months of age.

	T1		T2		T3	
	Girls (n=17)	Boys (n=17)	Girls (n=15)	Boys (n=16)	Girls (n=14)	Boys (n=16)
1. Activity	.47	.52	.32	.37	.41	.28
2. Rhythmicity	.72	.79	.63	.60	.56	.54
3. Adaptability	.33	.38	.42	.34	.47	.37
4. Approach	.57	.78	.63	.45	.69	.53
5. Threshold	1.06	1.16	1.09	1.19	1.09	1.07
6. Intensity	1.03	1.01	.96	1.01	.97	1.10
7. Mood	.45	.47	.46	.49	.55	.46
8. Distract'ty	.72	.75	.45	.44	.46	.33
9. Persistence	.67	.69	.87	.86	.91	.93
T-Sq.	4.37		9.59		9.97	
df	9,22		9,21		9,20	
p	.94		.63		.64	

test this, Hotelling's T-Square was applied, looking for differences between the sexes' mean temperament ratings. For this sample, there were no differences between ratings for boys and girls at 3, 6 or at 9 months of age. (See Table 9 for means and T-Square values).

These results, however, concern only the group as a whole. What about the intra-individual stability of these traits, as rated by the mothers? To answer this question, cross-time correlations were calculated for each of the nine temperament traits, and results are presented in Table 10. These correlations indicate that ratings of approach, intensity and mood remained fairly consistent throughout the 3 to 9 month age range, with significant correlations between 3 and 6, 6 and 9, and 3 and 9 months. Rhythmicity

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Table 10

Cross-time correlations for ratings on the Carey Survey of Infant Temperament.

Times Compared:	3 - 6 Mos. (n=31)	6 - 9 Mos. (n=30)	3 - 9 Mos. (n=30)
Activity	.23	.63***	.16
Rhythmicity	.64**	.46*	.29
Adaptabiliy	.44*	.68***	.24
Approach	.66***	.62***	.54**
Threshold	.30	.50**	.34
Intensity	.37*	.71***	.50**
Mood	.64***	.64***	.48**
Distractability	.61***	.16	.50**
Persistence	.15	.35	.36*

*p<.05 **p<.01 ***p<.001

and adaptability were correlated between 3 and 6, and 6 and 9 months, but not in the longer term. By six months of age, mothers' ratings of all of the traits except distractability and, perhaps, persistence, seem to stabilize.

It is interesting to note that Thomas and Chess (1977) found activity and adaptability to be the most consistent of the temperament traits in the one to five year age range, with rhythmicity, intensity and mood stable from one year to the next, but not in the longer term. In the present study, all of these ratings were significantly correlated between 6 and 9 months of age, and all but activity were correlated between 3 and 6 months as well.

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D. Observation Results

The results to be discussed in the following sections are based on the superordinate summary variables described in the Table 2 of the Methodology chapter.

When looking at the results of the observational data, several trends are apparent. In particular, Figure 1, which graphically presents the data for the maternal variables is striking in its uniformity: over the six months of the study, all forms of positive involvement of the mother with her infant decreased significantly, even though the proportion of time the two were together remained constant. At the same time, the number of restraints and reprimands increased slightly, however even at its maximum at 9 months, it still had a mean occurrence level of only 1.6% (See Table 11 for means and anova results).

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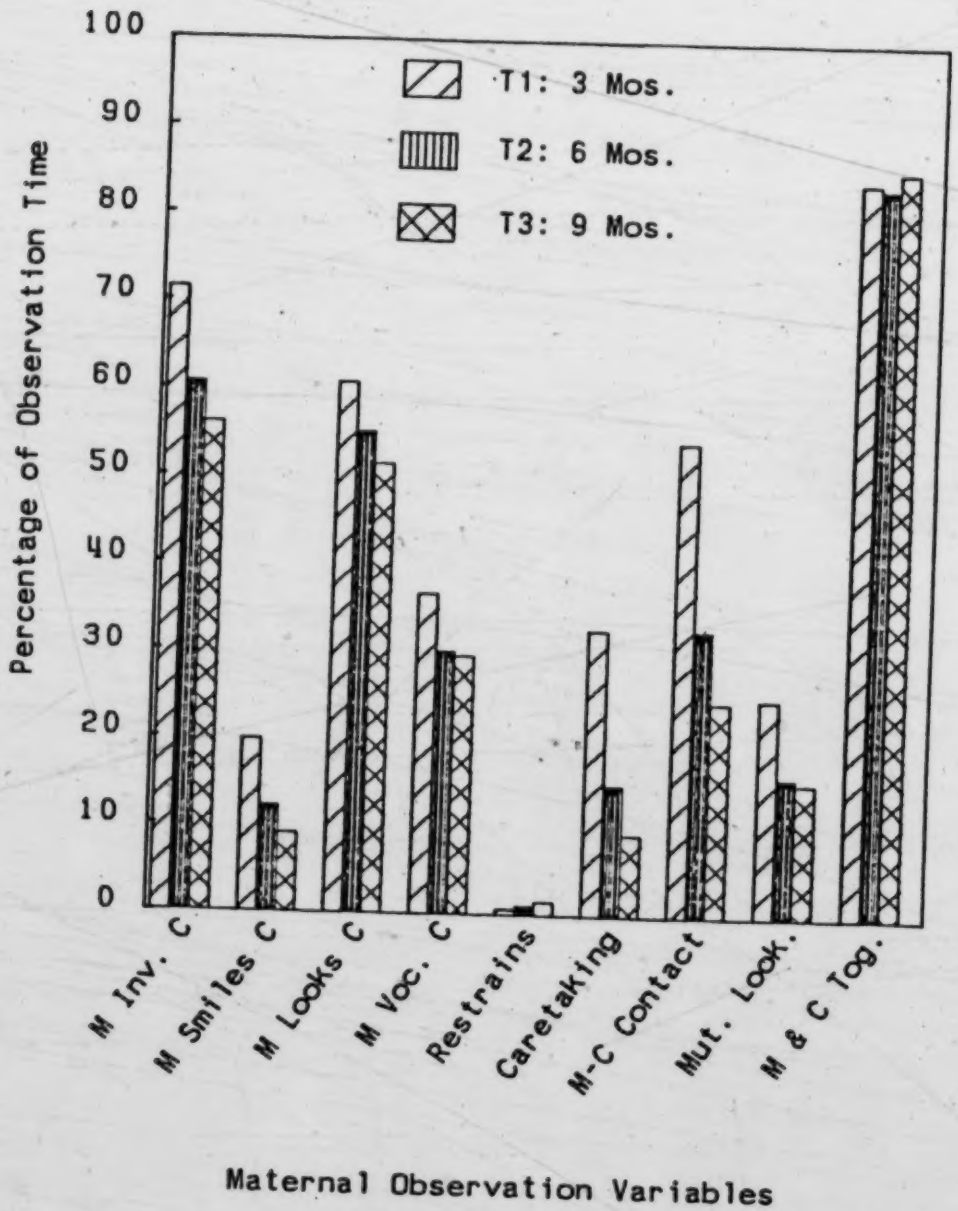
These changes are generally in accord with those expected from other research and general observation: as the infants grow more self-sufficient, the proportion of time mothers need to spend with them decreases. This lends some contextual validity to the data collection procedure in regard to positive interaction categories.

It is interesting to note that these particular mothers spent the majority of their time somehow involved with their infants, even if they were also occupied with housekeeping tasks. At three months, the average mother was looking at, or actively interacting with her infant 71.5% of the observation time. At 9 months, although this proportion had

Figure 1

Frequencies of maternal observation variables.



decreased, involvement with the infant was still coded during more than half of the observation records. (Note that all of these figures must be interpreted in the context of 'behaviour in the presence of an observer', and thus they may be somewhat biased.)

Unfortunately, few infant studies have reported descriptive statistics such as these for comparison purposes. The closest approximation is Clarke-Stewart's (1973) statistics on 36 lower S.E.S. mothers and their 10 month old infants. Reported means from that study for comparable variables are as follows (with 9 mo. means from this study given in parentheses): looking at infant, 39.0% (51.5% here), positive emotional expression, 5.4% (9.1%), verbal stimulation, 23.6% (29.7%), and restrains infant, 18.2% (1.6%). Overall, the mothers in the current study seem to be more 'child- oriented' than those of Clarke-Stewart, giving more positive attention, and being very much less restricting. These differences are in line with those predicted on the basis of other research into the effects of differences in socio-economic status (documented in Bayley & Schaeffer, 1960; Lytton, 1976; and Zegiob & Forehand, 1975, among others). Unfortunately, exact comparisons between the studies are impossible because of differences in definition and operationalization of the variables.

Concurrent with the mothers' decreasing involvement with their infants is a corresponding switch in the babies' interest toward more play and toy involvement. As opposed to

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Table 11
Means, standard deviations and Anova results for the observational variables.1

	T1 Mean (S.D.)		T2 Mean (S.D.)		T3 Mean (S.D.)		F
Comparison:	3-6 Mos.		6-9 Mos.		3-9 Mos.		
I. Maternal Observation Variables:							
M. Inv. C.	72.6 (12.8)	**	60.6 (18.0)	*	56.1 (18.1)	**	18.4***
M. Smiles C.	20.3 (11.4)	**	12.6 (9.9)		9.1 (7.6)	**	17.8***
M. Looks C.	61.3 (14.8)	*	54.9 (17.5)		51.5 (18.7)	**	8.2**
M. Voc.	40.5 (16.4)	**	32.9 (14.9)		33.2 (14.5)	**	7.4*
M. Voc. C.	37.2 (15.7)	**	30.4 (15.2)		29.7 (15.0)	**	9.4***
M. Rest. C.	0.7 (1.5)		1.1 (1.7)		1.6 (1.5)	*	3.5
Caretaking	33.7 (11.0)	**	14.8 (10.0)	**	9.4 (6.1)	**	83.2***
M.-C. Contact	55.5 (14.1)	**	33.0 (15.4)	**	24.6 (12.1)	*	50.6***
II. Child Observation Variables:							
C. Inv. M.	38.4 (11.8)	*	25.0 (8.8)		26.2 (6.1)	*	26.1***
C. Smiles M.	6.2 (3.9)		5.9 (4.2)		5.3 (4.6)		0.5
C. Looks M.	30.3 (10.1)	**	22.0 (7.8)		23.6 (6.0)	**	11.1**
C. Fusses	10.2 (5.3)	**	7.0 (5.1)		5.6 (3.9)	**	8.4**
C. Toy Inv.	34.6 (12.8)	**	63.3 (9.7)		64.5 (11.7)	**	67.9**
Gross Motor P.	45.8 (14.7)	*	53.7 (11.0)		52.5 (11.7)	*	3.9
Fine Motor P.	23.8 (11.8)	**	30.2 (9.8)		34.2 (11.5)	**	10.1
C.-M. Contact	11.2 (8.2)	**	4.4 (3.5)		5.0 (3.1)	**	16.6
C. Voc.	19.5 (10.1)		20.6 (8.4)		22.9 (7.2)		1.6
C. Voc. M.	15.1 (8.7)		16.1 (7.5)		19.3 (6.8)	*	3.5

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Table 11 (cont'd.)

Means, standard deviations and Anova results for the observational variables.1

	T1 Mean (S.D.)		T2 Mean (S.D.)		T3 Mean (S.D.)		F
Comparison:	3-6 Mos.		6-9 Mos.		3-9 Mos.		
III. Mutual and Miscellaneous Variables:							
C. Unconstr'nd.	9.6 (12.9)	**	38.5 (22.6)	**	54.1 (21.4)	*	41.2***
Mutual Looking	25.6 (8.8)	**	16.0 (6.4)		15.4 (5.5)	*	24.9***
M. & C. Tog.	84.6 (11.5)		83.8 (15.1)		85.5 (8.9)		0.3
Bkgnd Noise	40.9 (30.8)		40.8 (34.3)		51.71.5 (39.4)		

*p<.05 **p<.01 ***p<.001
1. Intercolumn significance values are for post-hoc Newman-Keuls tests between 3 and 6, 6 and 9, and 3 and 9 month means, respectively.

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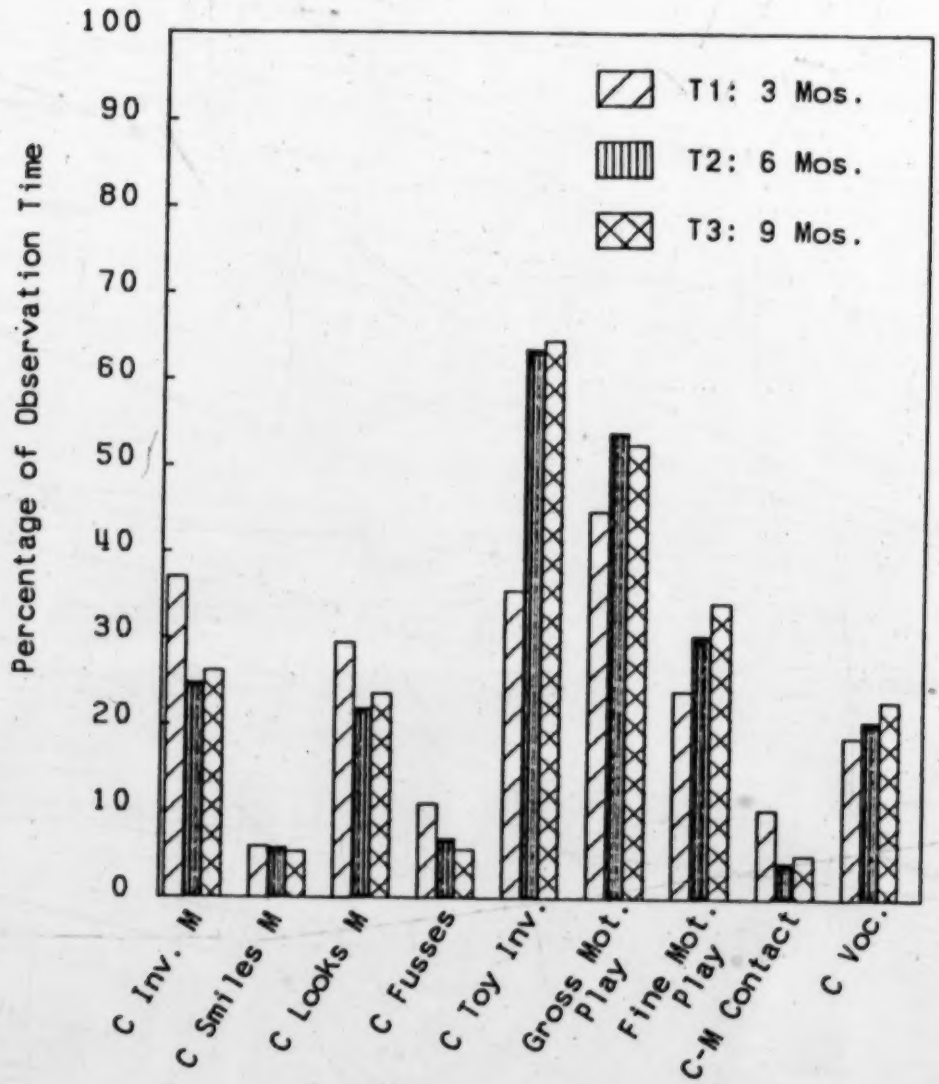
the steady decrease in maternal interaction variables over all six months of the study, however, the change in infants' behaviour seems to occur between 3 and 6 months, with less change between 6 and 9 months. Between 3 and 6 months there are significant decreases in involvement with, looking at and physical contact with the mother. At the same time, there are significant increases in toy involvement, and in gross and fine motor play. None of these differences is significant between 6 and 9 months of age. (See Figure 2 and Table 11 for the infant variable means and comparisons.)

Comparisons of the means for these infants at 9 months,

Figure 2

Frequencies of infant observation variables.



with Clarke-Stewart's (1973) 10 month olds indicate somewhat more similarity for the babies than found for the mothers. The means here are; involvement with the mother, 22.3% (26.2% in this study), toy or object involvement, 43.0% (64.5%), and fussing, etc. 8.0% (5.6%). Again, exact comparisons are impossible because of methodological differences.

E. Factor Analysis

In order to examine the variables for inter-relationships, including those relating to time or age, a factor analysis was carried out. All mother-infant pairs from each phase of the study were used to examine the structure of the 35 major variables (9 temperament ratings, 2 Bayley scores, and 24 observation categories). The resulting 95 x 35 matrix was analyzed using a principal components method, then the communalities from this solution were inserted into the matrix diagonal for a true factor analysis. A scree test indicated that 11 factors should be retained, and these were rotated to a varimax criterion. The resulting factor loading matrix is presented in Table 12. These 11 factors accounted for 69.9% of the variance included in the altered correlation matrix. After inspection, the factors were labelled as follows:

I. Mother's positive attention to the child: This is the strongest factor, accounting for 13.7% of the total and

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TABLE 12

Factor Analysis Results.
True factor solution, varimax rotation.
Only loadings of .30 or more are given.
(n = 95)

Variables	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	h^2
Bayley Mental									.585			.544
Bayley Motor									.814			.756
Activity			.500									.361
Rhythmicity								.805				.686
Adaptability				.855								.800
Approach				.650								.598
Threshold							.705					.539
Intensity							-.541					.362
Mood				.712			.374					.722
Distractability		.329		.354						-.339		.486
Persistence			-.490				-.397					.503
C Involv. M.		.865	.306									.962
C Smiles M		.449									-.300	.569
C Looks M		.917										.905
C Fusses						.824						.830
C Toy Involv.		-.539	-.486									.796
Gross Mot. Play			-.419							.304		.409
Fine Mot. Play												.655
C-M Contact		.423	.518							.699		.673
C Vocal.					.896							.887
C Vocal. M.					.954							.943
M Involv. C	.883											.946
M Pos. Exp. C	.551		.387									.804
M Looks C	.887										-.516	.885
M Vocal.	.743	.325										.734
M Vocal C	.815	.305										.842
M Restrains C												.706
Caretaking	.404	.381	.604								.793	.773
M-C Contact	.557		.638									.893
Mut. Looking	.415	.812										.881
C Unconstrained		-.401	-.417									.624
M & C Together	.617											.727
Bkgnd. Noise				.552				-.342				.417
M. Resp.						.367						.477
C. Resp.						.850		.384				.771
% TOTAL VAR.	13.68	10.90	7.73	6.50	6.17	5.65	4.00	3.92	3.82	3.81	1.30	
% COMMON VAR.	19.57	15.59	11.06	9.30	8.83	8.09	5.72	5.61	5.46	5.45	3.72	

19.6% of the common variance. It includes positive loadings for all aspects of positive attention to the infant, with all other variables having loadings of less than .30. This factor corresponds closely to that found by Clarke-Stewart (1973) with older children, which she labelled 'optimal maternal care'.

II. Child involvement with the mother: This factor incorporates positive loadings for most aspects of the babies' involvement with their mothers, with negative correlations for toy involvement and the proportion of time the child was unconstrained (largely 'not held'). There are also some moderate loadings for maternal involvement variables, however this might be expected from the young infant's dependence on the mother for the provision of interaction opportunities.

III. Independent play vs. mother involvement: Here, there are high positive loadings for variables indicative of active involvement with the mother, and negative loadings for variables associated with independent play or toy involvement.

IV. Easiness: Ratings of adaptability, approach and mood have the highest loadings on this factor. These, along with intensity and rhythmcity (which loaded only -.136 and .063, respectively) were used by Thomas, Chess and Birch (1963) to

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classify their subjects as 'easy' or 'difficult'. Distractability, which loads minimally on this factor, is not part of the set according to the original theory. It is interesting that Background Noise loads so strongly here. The question arises as to whether the babies have high scores on this factor because of the influence of music, television, etc., or whether mothers with less adaptable infants have less time or inclination to listen to these things.

V. Child Vocalization: Only the two measures of infant vocalization load more than .30 on this factor. It should be noted, however, that child vocalizes to mother is a subset of child vocalizes, and the two are very highly correlated. Therefore, the possibility exists that this factor may be, at least in part, a measurement artifact.

VI. Fussiness: This factor combines low levels of infant and maternal responsiveness with infant fussiness. This again, may be a measurement artifact, since both responsiveness indices are based on the amount of infant fussing or crying before and after an intervention.

VII. Reactivity: Again, this is a temperament factor incorporating high threshold and positive mood with low intensity and persistence. All of these seem indicative of the nature of the infants' reactions to stimuli, in terms of

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both direction and intensity.

VIII. Regularity/Rhythmicity: This factor is primarily one of rhythmicity of functioning, with lower loadings for amount of time the mother and infant were together, and maternal responsiveness ratings.

IX. Bayley Scores: Only the Bayley Mental and Performance Scale scores load on this factor.

X. Fine Motor Play: Here, fine motor play, toy involvement, and low distractability are combined, indicating the infant's tendency to be occupied with fine motor activities such as touching and manipulating toys.

XI. Emotional Expression: This factor is bipolar, with a positive loading for restraint and punishment of the child, and negative loadings for infant smiling and mother's positive emotional expressions.

F. Cross-Lagged Panel Analysis:

The principal rationale for collecting data on a longitudinal basis was the possibility provided for examining the inter-relationships of variables across time. In particular, the time element was to be used to look for the causal relationships among variables. Cross-lagged panel analysis was developed for this purpose, and is applied

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TABLE 13

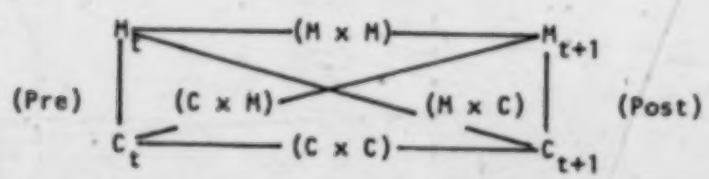
Cross-lagged, Contemporaneous, and Auto-Correlations for Maternal and Infant Variables, Assessed when the Infants were 3, 6, and 9 months old. (Only instances where there was a significant difference between cross-lagged correlations are included here)[1]

Lag in Mos.	Cross-Lagged Corrs.			Contemporaneous Corrs.			Auto-Corrs.		Partial Corrs.	
	M x C	C x M	t	Pre	Post	t	M x M	C x C	$r_{mc.c}$	$r_{cm.m}$
Activity and Factor I (Positive Attention):										
3-6	.20	.10		-.08	.30		.59	.22		
6-9	.56	.16	-2.34	.30	.42		.72	.63	.50	-.08
3-9	.33	-.14	-2.02	-.08	.42	-2.20	.67	.16	.35	-.12
Activity and M Involvement with C:										
3-6	.00	.11		-.35	.19	-2.35	.43	.22		
6-9	.50	.14	-2.04	.19	.47		.73	.63	.50	.00
3-9	.29	-.15		-.35	.47	-4.07	.67	.16		
Activity and M Looks C:										
3-6	.05	.07		-.25	.21		.60	.22		
6-9	.53	.11	-2.55	.21	.45		.82	.63	.52	-.11
3-9	.37	-.12	-2.06	-.25	.45	-3.25	.63	.16	.49	.04
Activity and M Vocalizes to C:										
3-6	.29	.03		-.01	.32		.75	.22		
6-9	.36	.23		.32	.32		.77	.63		
3-9	.31	-.19	-2.21	-.01	.32		.78	.16	.32	-.29
Activity and M - C Physical Contact:										
3-6	.11	.28		-.37	.14	-2.21	.17	.22		
6-9	.36	.05		.14	.20		.11	.63		
3-9	.39	-.45	-3.96	-.37	.20	-2.29	.44	.16	.49	-.34
Rhythmicity and M Vocalizes to C:										
3-6	.19	.11		.20	-.20	2.18	.75	.62		
6-9	-.39	-.16		-.20	-.17		.77	.46		
3-9	-.30	.19	2.29	.20	-.17		.78	.29	-.38	.06

TABLE 13
(Continued)

Lag in Mos.	Cross-Lagged Corrs. M x C	Cross-Lagged Corrs. C x M	t	Contemporaneous Corrs. Pre	Contemporaneous Corrs. Post	t	Auto-Corrs. M x M	Auto-Corrs. C x C	Partial Corrs.[3] $r_{mc.c}$	Partial Corrs.[3] $r_{cm.m}$
Threshold and M Vocalizes to C:										
3-6	.31	-.11		-.10	.18		.75	.29		
6-9	.17	.16		.18	.12		.77	.50		
3-9	.31	-.13	-2.10	-.10	.12		.78	.34	.37	-.08
Approach and M Positive Expression to C:										
3-6	.27	-.31	-2.80	-.05	-.23		.33	.66	.40	-.31
6-9	-.23	-.08		-.23	-.23		.51	.62		
3-9	.10	-.09		-.05	-.23		.60	.54		
Approach and M-C Physical Contact:										
3-6	-.09	-.14		-.31	.03		.17	.66		
6-9	.14	.42	-2.45	.03	-.39		.11	.62	.15	-.43
3-9	-.04	0.43		-.31	-.39		.44	.54		
Intensity and M Positive Expression to C:										
3-6	-.11	.04		.01	.06		.33	.66		
6-9	.18	-.35	-2.72	.06	-.02		.51	.62	.18	-.44
3-9	.24	.02		.01	-.02		.60	.54		
Intensity and M-C Physical Contact:										
3-6	.04	.13		.00	-.02		.17	.36		
6-9	.23	-.22		-.02	-.01		.11	.71		
3-9	.26	-.22	-2.21	.00	-.01		.44	.49	.30	-.25

[1] Correlations in each row represent the inter-correlations of two variables measured at 2 times (See the 'Lag' column for appropriate subscripts for the M and C variables.) The general pattern is as follows:



below. Briefly, three steps were used in this analysis. First the difference between the cross-lagged correlations for pairs of mother and infant variables were tested for significance. Secondly, the pattern of correlations among the variables at the various times was examined to determine directionality of effect, and, last, the partial correlations between the mother and infant variables was calculated, controlling for the earlier measurement of the variable thought to be 'caused'. (For a more detailed description of this analysis, see Chapter II.)

Cross-lagged panel analysis was applied to all possible pairs of the nine infant temperament ratings and the following maternal variables: positive attention (Factor I), overall involvement, smiles, visual attention, vocalizes to child, caretaking, M.- C. contact and maternal responsiveness. Total maternal vocalizations, was not included in this set because of the high correlation with vocalizations directed toward the child, child unconstrained and mutual looking were omitted because of the child component in the measurement, and restrains or reprimands was left out because its low frequency could lead to erroneous conclusions. With these exceptions, the complete inter-correlation matrix is presented in Appendix D. A summary of the instances in which there was a significant difference between the cross-lagged correlations is presented in Table 13, with the positions of the various correlation coefficients in the system diagrammed at the

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foot of the table. (Note that the temperament scores are all based on mothers' ratings of the children on the Carey Survey of Infant Temperament therefore they must be interpreted as maternal perceptions of infant temperament. For this section, the signs of correlations with the temperament ratings have been reversed so that a positive correlation indicates a positive relationship between the variables.)

The most consistent findings from the cross-lagged panel analyses involved the ratings of infant activity. Between 3 and 9 months of age, the relationships between rated infant activity and the indicators of 'voluntary' maternal involvement were reversed. At 3 months, high activity was related to low overall involvement, little visual attention and physical contact, and unrelated to positive attention and vocalization. Conversely, when the infants were 9 months of age, high activity ratings were associated with large amounts of attention, involvement, looking, vocalization and contact. To explain these results, one can conjecture that more active 3 month old infants may be more 'self-amusing' than inactive ones, demanding less attention from their mothers. By nine months, however, with the onset of mobility, active infants require and receive more attention and supervision.

The question then arises as to the most likely causal explanation for these changes: do active infants make their mothers more involved, or do involved mothers somehow make

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their infants more active? Or is the relationship one of mutual influence?

A problem arises here in the use of cross-lagged panel analysis with this particular set of data. As developed, this methodology is intended for application to 'mid-stream' processes, where the assumption of common factor structures for the tests at the two times is tenable. Here, both the young age of the infants, and the difference in sign of the contemporaneous correlations at 3 and 9 months make this assumption suspect.

In spite of these cautions, however, there are a number of indications that it is the mother that is the predominant influence in the changing relationship. For one thing, the cross-time correlations for maternal variables are generally higher than those for the activity ratings, indicating more consistency in the mother's behaviour than in the infant's rated temperament. Secondly, the t-test values are consistently negative, with the M-C lagged correlation always higher than its C-M counterpart. Lastly, the partial correlations remain high, even after taking the earlier child variable into account, eliminating this early child measure as a possible controlling influence. Therefore, the causal hypothesis which can best be supported with respect to these variables, is that high levels of maternal involvement and attention at 3 and 6 months results in higher activity levels at 9 months. (Or, conversely, that low maternal involvement leads to lower activity.)

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For the other temperament traits, there is much less consistency of pattern than for activity. Given the number of significance tests involved, some of the significant differences in cross-lagged correlations may be simply due to chance.

With regard to rhythmicity or regularity of functioning, the only significant difference occurs for the 3 and 9 month ratings with respect to maternal vocalizations to the infant. Overall, the relationship between the two is a diverging one, going from a positive correlation at 3 months ($r=.20$) to a negative one at 9 months ($r=-.17$). The pattern of correlations here seems to indicate that it is high vocalization levels by the mother at 3 months which leads to lower rhythmicity at nine months of age. The bases for this judgement include the fact that the correlation between early rhythmicity and later vocalization goes to nearly zero when controlling for early vocalization, the higher auto-correlation for the maternal variable, and the higher absolute value of the M - C lagged correlation compared to the corresponding C - M correlation.

Maternal vocalizations to the child are also associated with changes in stimulus threshold. Using a similar rationale to that for rhythmicity and vocalization, the most likely hypothesis would again seem to be that high levels of maternal vocalization to the infant at 3 months result in an increase of the infant's threshold for reacting to stimuli at 9 months of age.

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For the temperament trait of approach/withdrawal, the cross-lagged correlation differences were significant for positive maternal expressions (between 3 and 6 months), and for M-C physical contact (between 6 and 9 months). In both of these, there is a diverging relationship, with almost no correlation at the earlier time and moderate negative relationships later. In both cases, the magnitude of the cross-lagged correlations, and the relative instability of the maternal observation variables indicate child influence affecting this change. Specifically, a high rating of infant approach at 3 months appears to lead to less smiling and praise from the mother at 6 months of age and high levels of approach at 6 months may decrease physical contact by the mother at 9 months. (Or, conversely, after a 3 month lag, low approach may lead to more positive expressions at 6 months and more physical contact at 9 months.) The latter of these hypotheses appears somewhat more tenable than the former. An infant who willingly approaches and accepts new situations or stimuli may well be seen as requiring less direct physical contact later in time. It is difficult, however, to find a rationale to explain mothers' reacting more positively to infants seen as withdrawing from new situations. Indeed, this is contrary to current theories and research in the area (e.g. Bell, 1974; Goldberg, 1977; and Lewis and Lee-Painter, 1974).

The last two significant cross-lagged correlations involve infant intensity with maternal positive expression

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and physical contact. Although there is essentially no contemporaneous relationship between intensity and positive expression at any of the three ages, between 6 and 9 months the cross-lagged correlations are very different, with the magnitude of the correlations indicating that high intensity of reactions by the infant at 6 months may decrease the amount of smiling and praise received from the mother at 9 months of age.

With regard to intensity and mother-child contact, directionality of effect is very unclear, and the most plausible hypothesis may be one of mutual causation, with high levels of maternal physical contact with the infant at 3 months tending to increase intensity at 9 months, and also, high intensity of reactions by the infant at 3 months leading to low levels of physical contact at 9 months of age.

To summarize, the pattern of correlations between maternal observation variables and infant temperament ratings suggests the following hypotheses:

- Maternal voluntary involvement (Positive attention, overall involvement, looking, vocalizations, and physical contact) at 3 and 6 months may result in increased infant activity at 9 months.
- High levels of vocalization by the mother at 3 months may result in less infant rhythmicity or regularity of functioning and a higher sensory threshold at 9 months of age.

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- A high rating of infants' approach to new situations at 3 months may lead to fewer positive expressions by the mother at 6 months, and high approach at 6 months may reduce physical contact from the mother at 9 months of age.
- High intensity of infant reactions at 6 months may decrease maternal smiling, praise, etc. at 9 months.
- For the relationship between intensity and physical contact, the direction of effect is unclear, and the most likely hypothesis may involve mutual effects, with high intensity at 3 months decreasing amount of contact, and high contact levels at 3 months increasing intensity at 9 months.

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All of these are intriguing possibilities, suggesting interesting and important areas for further research. They must all, however, be regarded with some caution, because of the analysis problems noted above.

G. Exploratory analyses: Activity Correlates

The results of the cross-lagged panel analysis indicated that ratings of infant activity were associated with many forms of maternal involvement, and that the pattern of this association changed with the age of the infant. The question which arises here, concerns what exactly is being measured by Carey's 'activity' scale.

Table 14

Contemporaneous correlations between activity ratings and theoretically and statistically related variables. (Note that a negative correlation with the activity ratings indicates a positive relationship.)

	Carey Activity ratings		
	T1	T2	T3
Observational Measures:			
Gross Motor Play	-.03	-.02	-.31
Fine Motor Play	.03	.23	.17
M. Inv. C.	.35	-.19	-.47.
M. Looks C.	.25	-.21	-.45
M - C Phys. Contact	.37	-.14	-.20
Mutual looking	.06	-.14	-.38
Observational Ratings:			
Activity level	-.07	-.16	-.46
Physical Contact: Amount	.42	-.24	-.17
Closeness	.07	-.37	-.18
Vigor	-.02	-.46	-.16
Stim. with Materials	.01	-.21	-.38
Social Stim.	.09	-.31	-.41
M. Resp. to Social Exp.	-.04	-.10	-.52
M. Speed of Resp.	.08	-.06	-.40
M. Effectiveness	-.06	-.26	-.38
Approp. of M. Behaviour	-.01	-.29	-.63
C. Resp. to M. Social Exp.	-.07	-.19	-.38
Bayley Scales and Ratings:			
Motor D. Q.	.20	-.35	-.27
Body Tension	.39	-.12	-.17
Activity rating	.17	-.08	-.25
Body Motion Interest	.01	-.08	-.25
Body Motion Interest	.01	-.07	-.16
Energy Level	.05	.12	-.22
Endurance	-.35	.00	-.34
Gross Muscle Coord.	.21	.23	.21
Fine Muscle Coord.	.18	.10	-.22
Mouthing Pacifier	-.03	.37	-.13

Minimum Correlations for significance:
$p<.05$; $r=.36$: $p<.01$; $r=.47$: $p<.001$; $r=.59$.

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Examination of the scoring protocol reveals that 6 questions are included in the weighted average. Of these, four reflect behaviours in the caretaking situations of feeding, dressing and bathing, and only two involve movement levels during independent activities such as sleep and play. Thus, the activity rating appears to be heavily weighted toward movement during interaction with the mother.

As a further method of determining what the activity scale is measuring, patterns of correlations were examined between activity ratings and, a) variables which should theoretically be somewhat related, and b) variables which actually are significantly correlated were examined. These correlations are presented in Table 14.

At 3 months of age, the ratings of infant activity were more related to measures of maternal involvement and contact than to any infant variables. Indeed, the only significant correlation between rated activity and infant variables was with rated body tension during the administration of the Bayley Scales.

At 6 months of age, as well, there were few significant correlations between activity ratings and theoretically related measures. There were, however, a few correlations which lend some construct validity to the measure. At this time, activity ratings were positively and significantly related to the closeness and vigor of physical contact with the mother as rated by the observers. There is also some

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relationship to the Bayley Motor development score, and some tendency for babies with more active ratings to be less interested in pacifiers.

It is at 9 months that the Carey activity ratings have the most relationships with other variables. At this time, rated activity is significantly related to the observers' ratings of activity, and the correlation with the observational measure of gross motor play at least approaches significance. As well, activity is associated with many of the indicators of maternal involvement and stimulation from both observational measures and observers' ratings.

In summary, the mothers' ratings of infant activity on Carey's scales appear to have the most validity when the babies are at least 9 months of age, and the least relationship to other variables at 3 months of age. Unfortunately, the design of this study does not permit one to chose among alternative explanations for this finding. It may be that maternal ratings are based on a larger sample of behaviour than that sampled during the observations, leading to inconsistency in the results, particularly at early ages where there is less stability of behaviour. Or, the questionnaire may be sampling a qualitatively different aspect of 'activity' than that recorded during observervations because of its heavy emphasis on mother-oriented situations. At any rate, it is clear that additional research needs to be conducted into the adequacy

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of the questionnaire, particularly for younger infants.

H. Exploratory Analyses: Activity Profiles

The previous analyses have indicated relationships between rated activity and maternal attention which appear to change with time. In order to further investigate these relationships, subjects were divided into activity-profile groups, using Ward and Hook's (1963) hierarchical-profile-grouping analysis. [1] A scree test of the error terms indicated an optimal level of 5 groups, with a very large increase in the error term resulting from a further amalgamation of subjects. (See Appendix E for scree test and error terms.)

Of the 5 groups formed using this analysis, the largest consisted of infants whose rated activity levels were consistently high at all three ages. This will be termed the H-H-H group. (n=13, Mean ratings=.36, .18 and .21 over time.) The second largest group had ratings that were moderate at 3 months, but increased at 6 and 9 months. This will be termed the L-H-H group (n=9; Mean ratings=.80, .30 and .35). Group 3 has a high-moderate-high (H-M-H) pattern, and consists of infants whose activity ratings were initially high, then decreased at 6 months, recovering at 9 months (n=4; Mean ratings=.29, .54 and .34). The means of

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[1] This analyses divides subjects into successively larger groups on the basis of their profile scores. For each level of grouping, an error index is reported, consisting of the sum of the squared differences within a group, divided by the number of people in the group, then summed over all groups.

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these three groups are presented graphically in Figure 3. The remaining infants fell into two groups, three babies with low-low-moderate profiles (Mean ratings=.72, .78, and .56) and one with steadily declining activity ratings (.40, .80 and 1.25). Because of the small number of subjects involved, these two groups were excluded from further analyses.

After the infants had been clustered into profile groups, a number of analyses of variance were calculated, looking for systematic differences in maternal behaviour corresponding to group membership. The variables analyzed in this context included mothers' overall involvement, their looking, vocalizing, caretaking, and physical contact vis-a-vis the infant, and the percentage of time the infant was left on the floor for free play. Means for these variables are presented graphically in Figures 4 to 9, with the corresponding analysis of variance source tables given below.

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Figure 3

Mean activity ratings for three profile groups.
(Low scores indicate high activity.)

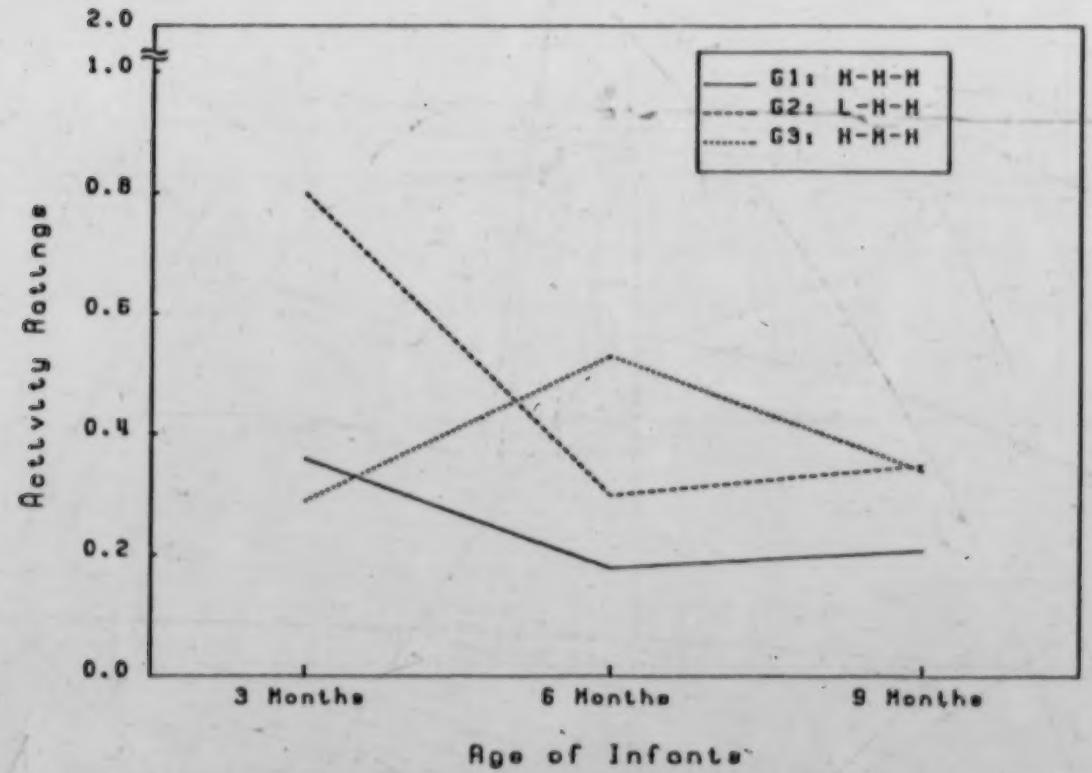

Figure 4
Mean maternal involvment with the infants in the three activity profile groups.

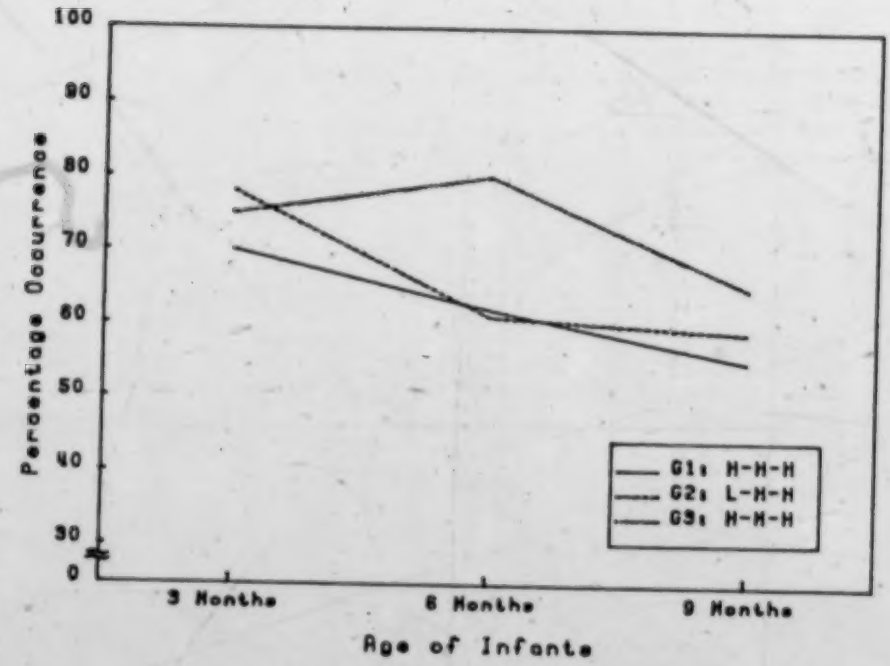

Table 15
Repeated measures analysis of variance for maternal involvement with infants in the three activity profile groups.

Source	SS	df	MS	F	p
Between subjects	1.210	25			
Activity	0.127	2	0.064	1.332	.284
Ss within gps	1.098	23	0.048		
Within subjects	0.912	52			
Time	0.212	2	0.106	9.167	.000
Group x time	0.084	4	0.021	1.802	.145
Time x subjects within gps.	0.533	46	0.012		

Figure 5
Mean occurrence of mother looks at child for the three activity profile groups.

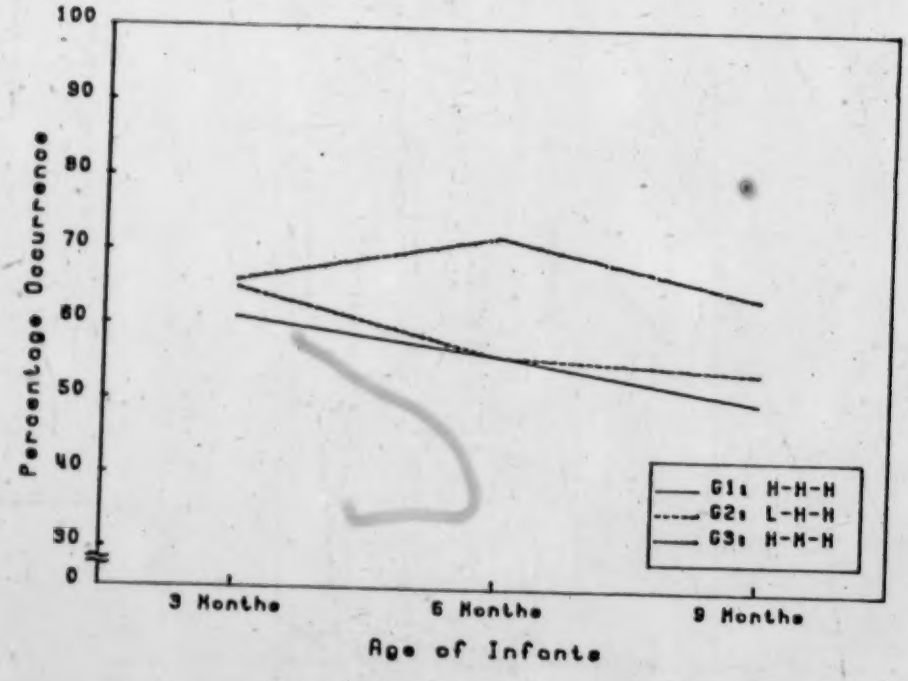

Table 16
Repeated measures analysis of variance for percentage occurrence of mother looks at child for the three activity profiles.

Source	SS	df	MS	F	p
Between subjects	1.535	25			
Activity	0.150	2	0.075	1.219	.314
Ss within gps.	1.413	23	0.061		
Within subjects	0.582	52			
Time	0.064	2	0.032	3,401	.042
Group x time	0.045	4	0.011	1.204	.322
Time x subjects within gps.	0.434	46	0.009		

Figure 6
Mean occurrence of mother vocalizes to child for the three activity profile groups.

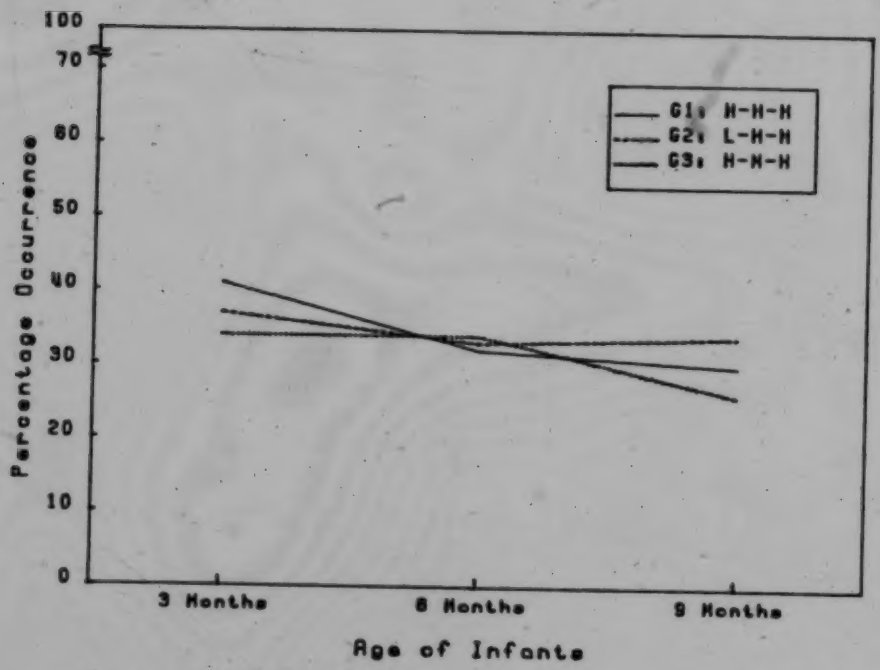

Table 17
Repeated measures analysis of variance for percentage of time mothers vocalized to infants in the three activity profiles.

Source	SS	df	MS	F	p
Between subjects	1.329	25			
Activity gp	0.017	2	0.008	0.146	.865
Ss within gps	1.317	23	0.057		
Within subjects	0.364	52			
Time	0.053	2	0.027	4.783	.013
Group x time	0.023	4	0.006	1.018	.408
Time x subjects within	0.257	46	0.006		

Figure 7
Mean caretaking time for infants in each of the three activity profile groups.

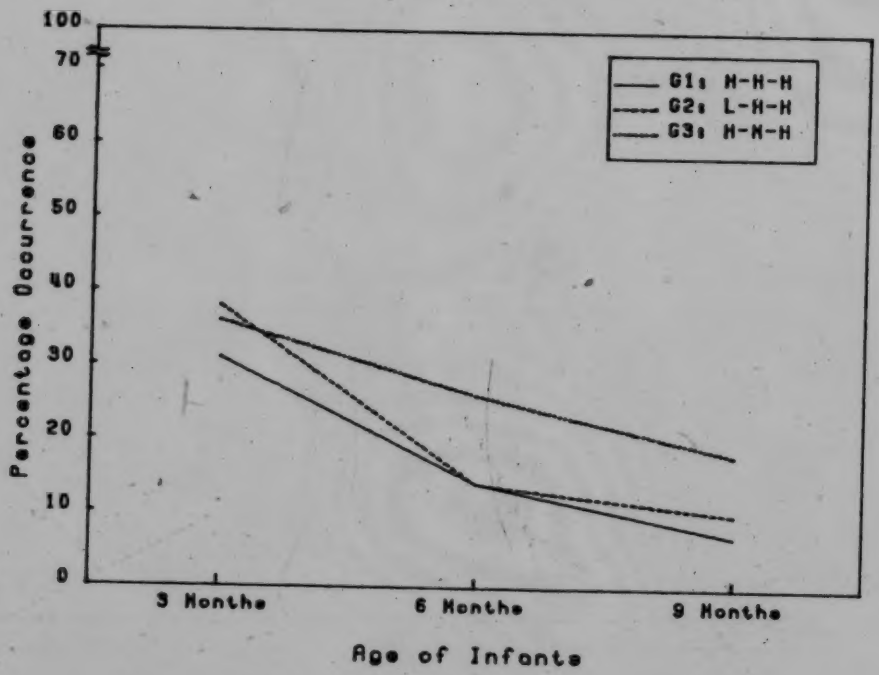

Table 18
Repeated measures analysis of variance for maternal caretaking time for the three activity profiles.

Source	SS	df	MS	F	p
Between subjects	0.325	25			
Activity	0.084	2	0.042	3.892	.035
Ss within gps.	0.250	23	0.011		
Within subjects	1.139	52			
Time	0.585	2	0.292	47.120	.000
Group x time	0.035	4	0.009	1.395	.251
Time x subjects within gps.	0.285	46	0.006		

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Figure 8
Mother-Infant physical contact means for the three activity profile groups.

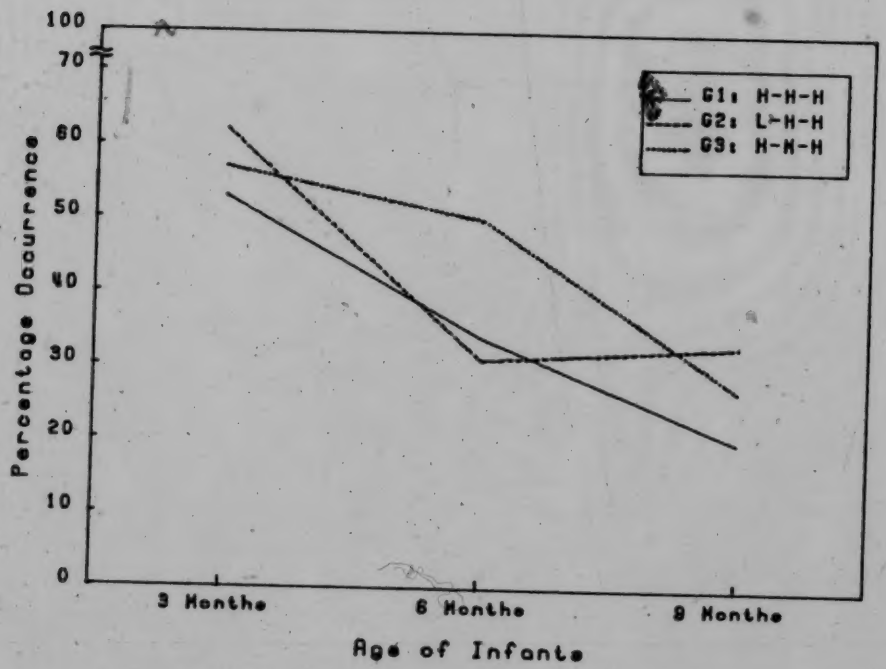

Table 19
Repeated measures analysis of variance for amount of physical contact from mother to child for the three activity profiles groups.

Source	SS	df	MS	F	p
Between subjects	0.570	25			
Activity	0.085	2	0.042	2.103	.145
Ss within gps.	0.464	23	0.020		
Within subjects	2.091	52			
Time	0.974	2	0.487	34.274	.000
Group x time	0.133	4	0.033	2.331	.070
Time x subjects within gps.	0.654	46	0.014		

Figure 9
Mean time infant left unconstrained for each of the three activity profile groups.

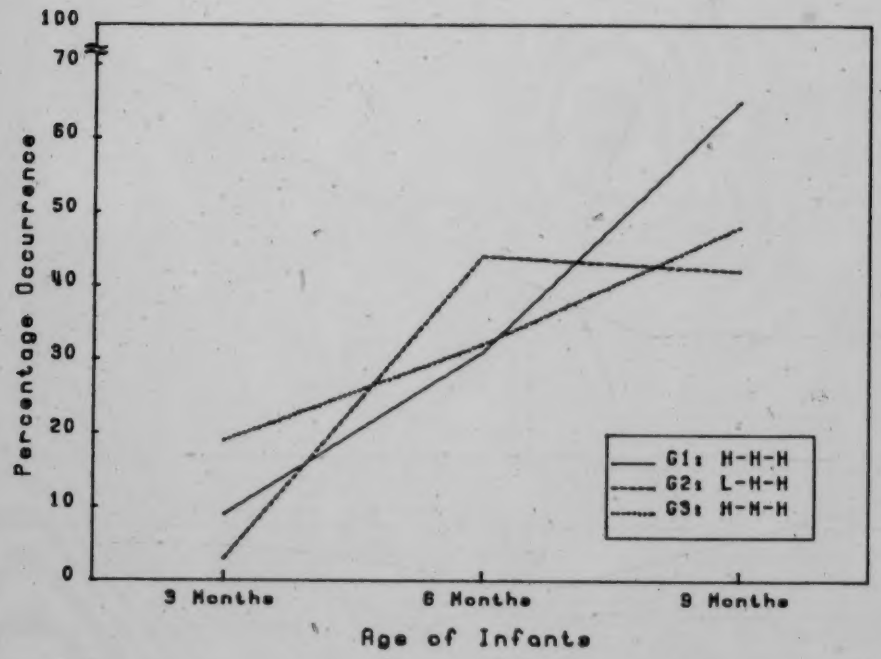

Table 20
Repeated measures analysis of variance for percentage of time the infant was left unconstrained for three activity profiles.

Source	SS	df	MS	F	p
Between subjects	0.875	25			
Activity	0.026	2	0.013	0.354	.705
Ss within gps.	0.836	23	0.036		
Within subjects	4.590	52			
Time	1.778	2	0.889	29.334	.000
Group x time	0.330	4	0.083	2.726	.041
Time x subjects within gps.	1.394	46	0.030		

From these six analyses, there was an overall group effect only for percentage of caretaking time (See Figure 7). Here a Scheffe post-hoc comparison indicated that the H-M-H activity group (Group 3) received significantly more caretaking than the H-H-H group (Group 1). They also received more caretaking than the L-H-H infants (Group 2) at 6 and 9 months, although this difference was not significant. The means for maternal involvement with, looking at and physical contact with the infant all show similar relationships: at 6 months of age, when the activity level of group 3 is most different from those of groups 1 and 2, the level of involvement, looking and contact for group 3 is significantly higher than for the other two groups. At 3 and 9 months, where there was less difference in activity ratings, there was also less difference in maternal behaviour. (Although the overall interaction effect for these analyses was insignificant, post hoc Scheffe tests did indicate significant differences between group 3 and groups 1 and 2 in each of these analyses.)

A different pattern occurs for mean time the infants were unconstrained, ie. not being held or in some constraining device. Here, there is a significant group by time interaction, with a Scheffe test indicating that the H-H-H group spent significantly more time unconstrained than either the L-H-H or the H-M-H group at 9 months of age. There were no group differences for amount of vocalization from the mother to the infant. This variable appears to be

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independent of rated activity. It will also be noted that in each analysis there is a significant time effect as the levels of all types of interaction decreased, and the percentage of time unconstrained increased with age.

Thus, there appears to be some relationship between mothers' perceptions of infant activity level and their pattern of involvement with the infant over time. Although the results are not generally significant, the overall pattern appears to be fairly uniform. With larger numbers of subjects, the results might have been more clear-cut.

I. Exploratory Factor Analyses

The changing nature of several of the correlations reported previously brings up the question of stability of the factor structure over time. In order to investigate this, three exploratory factor analyses were computed. In the original factor analysis reported in Chapter 3, variables were treated as equivalent regardless of time of assessment, resulting in an analysis with 35 variables and 95 subject pairs. This analysis was based on the assumption that, for example, 'M. looks C.' at 3 months of age was essentially the same as 'M. looks C.' measured at 6 or 9 months. While simplifying the analysis, this assumption may have obscurred differences in factor pattern related to the age of the infant during the interaction.

In order to investigate this question of factorial invariance over time, exploratory factor analyses were

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calculated which treated each variable measured at each time as separate and distinct. Because of the large number of variables thus 'created', it was necessary to break them down into a number of subsets for analysis. The subsets used were: maternal observation variables, infant observation variables, and infant temperament ratings. All possible pairs of these subsets were then factored, using principal components solutions with varimax rotations.

Even though the variables were broken down in this manner, there were still more variables than subject pairs in each of the analyses because of the tripling effect of treating each time measurement as separate. The two predictable statistical effects of this are an artificial enhancement of the correlation matrix, and a number of zero eigenvalues in the factor solution. To compensate somewhat, a higher loading was required for a variable to be considered to load 'significantly' on a factor. In the results to follow, .40 was used as the arbitrary cutting point used for a variable to be considered to load on a factor, rather than the more usual .30. Because of the small sample size, the results of the factor analyses must certainly be regarded as exploratory. In spite of these problems, however, it is argued here that a tendency for the a variable measured at different times to load on a single factor can be regarded as evidence for the stability of the factor structures over the ages studied.

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Temperament ratings and Maternal Observation Variables:

For the first of the three exploratory factor analyses, the 9 temperament ratings from Carey's Infant Temperament Survey were combined with 7 maternal observation variables. The most interpretable solution of the resulting 30 x 48 matrix involved the varimax rotation of 3 factors, and this factor loading matrix is presented in Table 21. After examination, the factors were labelled as follows:

I. Maternal involvement with the child: Eighteen of the 21 maternal observation variables had loadings of more the .50 on this factor, with all variables having loadings of more than .30. There were no infant variables with significant loadings. Thus, this is clearly a factor indicating a clustering of maternal behaviour which is relatively independent of the age of the infant.

II. Easiness: Again, there are fairly consistent loadings for variables measured at different times, with high correlations for ratings of adaptability, approach, and mood at all 3 ages. Threshold also loaded on this factor at 3 months, and to a lesser extent, at 6 and 9 months. Intensity (low) is included at 6 and 9 months. There is only one maternal variable with a loading of more than .40, and that is the 9 month index of proportion of time the mother and infant were together. All of the infant temperament variables which cluster here indicate 'easiness', and all

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TABLE 21

Factor Loading Matrix for Infant Temperament Ratings and Maternal Observation Variables (n = 30)

	Variables	H^2	1	2	3
Time 1	Activity	.363	.302	-.023	-.521
	Rhythmicity	.212	-.201	-.182	.372
	Adaptability	.488	-.131	.686	-.015
	Approach	.521	.330	.642	.005
	Threshold	.486	-.146	.611	.303
	Intensity	.355	.194	-.250	-.504
	Mood	.606	-.013	.755	.188
	Distractability	.197	.099	.340	-.269
	Persistence	.071	.159	-.177	.119
	M & C Together	.685	.738	-.127	-.353
	M. Inv. C	.705	.823	-.048	-.161
	M Smiles C	.324	.542	-.147	.098
	M Looks C	.723	.847	-.071	-.001
	M Voc. C.	.563	.706	-.096	.236
	Caretaking	.322	.567	.092	-.059
	M-C Contact	.529	.718	.057	-.106
Time 2	Activity	.196	-.132	-.274	-.322
	Rhythmicity	.266	.129	.171	.470
	Adaptability	.620	.064	.766	-.168
	Approach	.573	.168	.719	-.167
	Threshold	.176	-.185	.377	.016
	Intensity	.364	.179	.474	-.327
	Mood	.509	-.012	.713	-.009
	Distractability	.078	-.079	.267	.009
	Persistence	.052	.218	-.069	.002
	M & C Together	.458	.511	-.125	.426
	M Inv. C	.834	.702	.040	.582
	M Smiles C	.456	.551	.107	.376
	M Looks C	.782	.716	.088	.511
	M Voc. C	.676	.647	-.046	.506
	Caretaking	.495	.314	-.195	.598
	M-C Contact	.564	.310	-.120	.673
Time 3	Activity	.383	-.352	-.230	-.454
	Rhythmicity	.277	.015	-.126	.511
	Adaptability	.488	.111	.659	-.204
	Approach	.599	.273	.706	-.162
	Threshold	.232	-.264	.359	.184
	Intensity	.404	-.021	-.517	-.368
	Mood	.510	.142	.691	.108
	Distractability	.316	.225	.365	-.364
	Persistence	.111	.054	-.269	.189
	M & C Together	.621	.530	.501	-.298
	M Inv. C	.768	.790	.321	.203
	M Smiles C	.311	.553	-.014	-.067
	M Looks C	.684	.725	.331	.221
	M Voc. C	.631	.773	.023	.183
	Caretaking	.369	.384	-.280	.379
	M-C Contact	.670	.753	.229	-.225
	% TOTAL VARIANCE		20.16	14.71	10.17
	% COMMON VARIANCE		44.76	32.66	22.58

but threshold were included by Thomas et al. in their original definition. One variable which was included by Thomas et al., but which did not load significantly on the factor, is rhythmicity, which has no correlations above .20.

III. Six Month Involvement / Demandingness: The last factor centers around the 6 month maternal involvement variables, whose lowest loading was .38. In addition, three temperament variables load here, high intensity at 3 months, high activity at 3 and at 9 months, and low rhythmicity at 6 and 9 months. If the criterion for a 'significant' correlation is reduced from .40 to .30, all three of these temperament ratings load on this factor at all three times. This temperament cluster can be summarized as representing both 'demandingness', and involvement of the mother with her infant at 6 months of age.

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Temperament Ratings and Infant Observation Variables:

The second set of variables analyzed included 9 temperament ratings and 9 infant observation variables, resulting in a 30 x 54 matrix. Again, three factors were extracted, and rotated to a varimax critierion. (See Table 22 for the factor loading matrix.) These factors accounted for approximately a third of the total variance, and were labelled as follows:

I. Child's positive involvment with the mother: At 3 months,

TABLE 22
Factor Loading Matrix for Infant Temperament Ratings and Observation Variables
(n = 30)

	Variable	H^2	1	2	3
Time 1	Activity	.008	.058	.060	-.023
	Rhythmicity	.198	.004	-.420	.147
	Adaptability	.525	-.046	.551	.468
	Approach	.433	-.030	.600	.268
	Threshold	.406	-.330	.360	.409
	Intensity	.435	-.141	-.023	-.644
	Mood	.538	-.338	.521	.390
	Distractability	.360	.222	.556	-.034
	Persistence	.038	-.067	-.156	-.097
	C Inv. M	.594	.769	.006	.047
	C Smiles M	.429	.647	-.032	.098
	C Looks M	.444	.657	.050	-.132
	C Fusses	.292	-.511	.116	-.136
	C Toy Inv.	.333	-.438	-.376	.017
	Gross Motor P.	.046	-.168	-.089	.098
	Fine Motor p.	.081	.162	-.132	.194
	C-M Contact	.246	.420	-.090	.249
	C Voc. M	.315	.533	-.169	-.040
Time 2	Activity	.214	-.237	-.385	-.099
	Rhythmicity	.046	.123	.056	.165
	Adaptability	.627	-.214	.736	.196
	Approach	.645	-.399	.697	.025
	Threshold	.324	-.485	.068	.291
	Intensity	.579	.254	-.069	-.714
	Mood	.577	-.524	.538	.111
	Distractability	.137	.118	.331	.114
	Persistence	.258	.399	.222	-.222
	C Inv. M	.528	.673	.128	-.243
	C Smiles M	.309	.268	.268	-.407
	C Looks M	.425	.572	.133	-.284
	C Fusses	.284	-.298	-.399	.189
	C Toy Inv.	.242	-.101	.304	.373
	Gross Motor P.	.124	.064	.274	-.213
	Fine Motor P.	.066	.212	-.099	.104
	C-M Contact	.328	.543	-.071	.167
	C Voc. M	.157	.381	-.020	.107
Time 3	Activity	.162	-.194	-.229	-.268
	Rhythmicity	.073	.243	-.114	-.027
	Adaptability	.579	-.089	.752	.082
	Approach	.699	-.111	.828	-.033
	Threshold	.387	-.188	.004	.593
	Intensity	.631	.006	-.169	-.776
	Mood	.449	-.184	.604	.226
	Distractability	.450	-.073	.586	-.319
	Persistence	.144	.031	-.123	-.358
	C Inv. M	.384	.471	.395	-.077
	C Smiles M	.267	.513	-.018	-.058
	C Looks M	.270	.384	.252	-.242
	C Fusses	.268	.065	.272	-.436
	C Toy Inv.	.278	-.325	-.165	.381
	Gross Motor P.	.399	.301	.081	.549
	Fine Motor P.	.257	.381	.104	.317
	C-M Contact	.457	.519	.310	.302
	C Voc. M	.434	.127	.056	.644
	% TOTAL VARIANCE		12.27	11.83	9.56
	% COMMON VARIANCE		36.45	35.15	28.40

variables with high loadings on this factor included total involvement, smiles, looks, vocalizes, and physical contact, with negative loadings for fusses, and toy involvement. At 6 months, involvement, looking and contact were included, and at 9 months, involvement, smiles and contact had loadings of more than .40. Only at 6 months were there any significant temperament loadings. These included high approach, threshold and mood, and low persistence.

II. Easiness: As in the prior analysis, the second factor clearly represents 'easiness'. Here, adaptability, approach and mood loaded at all three times, distractability loaded at times 1 and 3, and rhythmicity loaded at time 1.

III. Intensity / Reactivity: The last factor centered around ratings of high intensity. Also included, however, were low adaptability at 3 months, and low threshold at 3 and 9 months. Together, the three seem to indicate a trait of 'reactivity' in the infant.

Mother and Infant Observation Variables:

The final variable set included seven maternal and nine infant variables in a 30 x 48 matrix. Here, the four factor solution was chosen on the basis of both a scree test and overall interpretability. The factor loading matrix is presented in Table 23. After inspection, the factors were labelled as follows:

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TABLE 23

Factor Loading Matrix for Mother and Infant Observation Variables

	Variable	H^2	1	2	3	4
Time 1	M & C Together	.641	.658	-.004	.437	.126
	M Inv. C	.783	.751	.050	.411	.195
	M Smiles C	.576	.243	.338	.389	.502
	M Looks C	.736	.806	.184	.223	.060
	M Voc. C	.520	.580	.353	.168	.176
	Caretaking	.430	.462	.120	.392	.221
	M-C Contact	.683	.624	.043	.451	.296
	C Inv. M.	.731	.224	.231	.790	.061
	C Smiles M	.528	.143	.377	.604	.001
	C Looks M	.409	.144	.269	.561	-.044
	C Fusses	.434	.335	-.432	-.291	-.224
	C Toy Inv.	.301	-.185	.137	-.462	-.185
	Gross Motor P.	.183	-.096	-.006	-.069	-.411
	Fine Motor P.	.195	.061	.117	.373	-.196
	C-M Contact	.430	.194	.033	.624	.030
	C Voc M	.328	-.084	.188	.432	.347
Time 2	M & C Together	.540	.224	.618	.259	.201
	M Inv. C	.863	.571	.727	.052	-.076
	M Smiles C	.486	.478	.376	-.119	.319
	M Looks C	.[illegible]	.657	.603	-.060	-.040
	M Voc. C	.693	.468	.679	.051	.007
	Caretaking	.778	.035	.880	.011	-.053
	M-C Contact	.706	.091	.805	.134	-.181
	C Inv. M	.845	.027	.739	.209	.505
	C Smiles M	.565	.348	.168	-.136	.630
	C Looks M	.703	.029	.598	.060	.584
	C Fusses	.253	-.039	.058	-.223	-.445
	C Toy Inv.	.642	-.109	-.718	.324	-.099
	Gross Motor P.	.512	.184	-.560	.068	.400
	Fine Motor P.	.494	-.428	-.260	.477	.128
	C-M Contact	.685	-.030	.673	.477	.064
	C Voc. M	.174	-.127	.041	.394	.037
Time 3	M & C Together	.501	.590	-.264	.103	.270
	M Inv. C	.846	.850	.281	-.192	.084
	M Smiles C	.797	.361	.136	-.060	.803
	M Looks C	.826	.829	.258	-.268	.012
	M Voc. C	.641	.684	.375	.003	.182
	Caretaking	.503	.209	.631	-.230	.093
	M-C Contact	.694	.830	-.030	.042	.037
	C Inv. M	.657	.093	-.156	.120	.781
	C Smiles M	.569	.066	.143	.101	.731
	C Looks M	.614	-.086	.001	-.091	.773
	C Fusses	.339	.555	-.114	.013	.134
	C Toy Inv.	.399	-.139	.038	-.040	-.614
	Gross Motor P.	.173	-.119	-.152	.356	.097
	Fine Motor P.	.532	-.300	-.076	.648	.125
	C-M Contact	.529	.273	-.184	.616	.202
	C Voc. M	.282	.139	-.229	.427	-.166
	% TOTAL VARIANCE		17.12	15.26	11.53	11.38
	% COMMON VARIANCE		30.97	27.60	20.85	20.58

I. Overall maternal involvement: The maternal variables of overall involvement, looking, and vocalization were included in this factor at all three times. Proportion of time together and M - C physical contact were included at 3 and 9 months, and caretaking and smiles were included at 3 and 6 months, respectively. Only two infant variables had loadings of more than .40; fine motor play at 6 months, and fusses at 9 months of age.

II. Six month interaction: The second factor incorporates 11 of the 16 mother and infant observation variables measured at 6 months of age. Only the two smiling indices, fussing, fine motor play, and C. Vocalizes to M. were not included at this time. As well, only two variables at other times (fussing at 3 months, and caretaking at 9 months) had loadings of more than .40.

III. Three month interaction: Although less clearly defined than Factor II., the third factor also appears to represent the interaction between mother and infant within a specific time frame, rather than combining measures across time. Of the three month variables, proportion of time together, maternal involvement, and maternal smiling, looking, contact and vocalization with the child are included, along with the child's involvement smiling, looking, contact and vocalization with the mother. Toy involvement also loads negatively at Time 1. Only three variables from later times

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load significantly on this factor; fine motor play and child contact with the mother (6 and 9 months), and vocalization toward the mother (9 months).

IV. Positive involvement: The last factor seems to be one of positive emotional contact between the mother and baby. Variables with significant loadings include mother smiles at infant (3 and 9 months), child smiles, looks and is involved with the mother (6 and 9 months), and low fussing (6 months).

From these analyses comes an answer to the original question of the stability of the factor structure over time. In both of the analyses where maternal observation variables were included, these loaded consistently on a single factor, indicating considerable stability over time. The same pattern has also been found by Clarke-Stewart (1973) for 10 to 14 months olds and by Clarke-Stewart et al. (1979) for 2 year olds. As well, a subset of the infant temperament ratings appears to be fairly stable across time. This is the 'Easiness' cluster, comprising a core of adaptability, approach, and mood, with threshold, distractibility, intensity and rhythmicity fitting into the cluster less consistently.

The variables with the least stability over time are the child observation measures, where there is a tendency for variables within a given age to cluster with

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contemporaneously measured maternal variables, rather than for variables measured at different times to load on common factors. This is particularly true in the Mother and Infant observation context, where there is no overall child behaviour factor, but rather several 'age' factors incorporating both mother and infant measures. When combined with temperament ratings, the child observation variables do cluster somewhat more, but even here the factor representing child involvement with the mother is heavily biased toward three month scores, with less contribution from Times 2 and 3.

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V. Summary and Conclusions

Conclusions for the study will be presented in the same general format as the results. Although a number of issues could be addressed here, the major emphasis will be placed on the original question of the effects of infant temperament on mother-infant interactions.

The Sample

Families included in the study were generally from middle- to upper-middle-class backgrounds, with high levels of education. The mothers tended to be 'child-centered' in terms of their groups of association, their knowledge and awareness of infant behaviour, and their extent of breast-feeding. This was a relatively privileged group, and their reactions may or may not be charactistic of the population at large.

The infants included were all first-born, full term, healthy babies, with average or above average ability levels as measured by the Bayley Scales of Infant Development. There were 14 girls and 16 boys in the final sample.

The Carey Survey of Infant Temperament

Generally, results from the Survey of Infant Temperament were similar in pattern to those found by Carey (1970) in his original research with four to eight month

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olds. Although Carey's means were significantly different overall from those for this sample ($p<.054$), there were no significant differences between the means of specific temperament traits. Between 3 and 9 months, there was a significant change in overall rated temperament. Post-hoc tests indicated that this was a result of distractability ratings which were significantly lower at 3 months than at 6 or 9 months of age. Contrary to much popular opinion, there were no differences between temperament ratings of boys and girls at any age.

Cross-time correlations of the nine temperament ratings indicated that ratings of rhythmicity, adaptability, approach, intensity and mood were all fairly stable from 3 to 6 and from 6 to 9 months of age. Ratings of activity level, and threshold were correlated between 6 and 9 months, but not earlier, and distractibility was stable from 3 to 6 months but not later.

Overall, the ratings of temperament appeared to be fairly stable, especially when one considers the lack of stability in other infant measures, particularly intelligence. One possible explanation for this stability is that it is really a function, not of actual infant behaviour patterns, but rather of continuing maternal perceptions of behaviour. It seems likely, however, that the specificity and behavioural nature of the questions used to assess the temperament traits helped to minimize this effect.

In general, distractibility and persistence appear to

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be the least useful of the temperament traits measured. They are the least stable across time, they load less consistently than the others on the various factors, and they have the fewest correlations with other variables. It may be that these two concepts are less applicable for young infants than the others, since their connotations are associated with independent activities which are much less common at this age.

General Observation Results

Two findings stand out with regard to the observation results. The first of these is the very large proportion of time these particular mothers spent somehow involved with their infants. At 3 months, in particular, mothers spent an average of 73% of the time during which they were observed (centered around a feeding) somehow involved with their babies. This percentage is reduced as the infants grow older, but at 9 months the mean was still 56%. It is no wonder that mothers of infants complain of never having any free time!

The second consistent finding concerns the steady decline in maternal behaviours vis-a-vis the infant. With the exception of 'restrains or reprimands', all maternal actions towards the infant declined significantly from 3 to 9 months, and a glance at Figure 1 reveals the linear nature of these trends. As expected, the number of restraints and reprimands increased from 3 to 9 months, however even at its

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maximum, this was coded less than 2% of the time.

Concurrent with this lessening involvement of the mothers with their infants is a corresponding switch in the babies' attention from the mother to toys and objects, as the periods of independent play grow longer. A glance at Figure 2 illustrates the nature and extent of these changes of focus.

Temperament and Maternal Behaviour

As in any study of interactions, the number of possible methods of data analysis is seemingly endless. Here, four methods have been used to examine the relationships: a factor analysis of the variables, using all mother-infant pairs at all times as the sample, a cross-lagged panel analysis, a hierarchical profile analysis, and finally, a set of exploratory factor analyses.

The initial factor analysis resulted in a number of fairly clear and interpretable factors. The strongest of these, accounting for 20% of the total variance, represented positive involvement of the mother with her infant. Even when allowed to load independently in the exploratory factor analyses, the maternal behaviour variables loaded consistently on the same factor, regardless of the age of the infant when they were measured, indicating that this cluster of variables is fairly stable across time. Similar factors have also been found by Clarke-Stewart (1973), and Clarke-Stewart et al. (1979) in studies of 10 to 14 month

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olds and 2 year olds.

The second factor was labelled child involvement with the mother, and the third igvolved a dichotomy between independent play and involvement with the mother. These factors, however, were less consistent over time in the exploratory analyses.

The fourth factor from this analysis represents an 'easiness' dimension, supporting, at least in part, the temperament theory originally formulated by Thomas, Chess and Birch (1968). In both of the methods of factor analysis used, 'easiness' is defined by a core grouping of adaptability, approach, and mood, with other traits included on a much more age specific basis. The remaining factors from this analysis were labelled child vocalization, fussiness, reactivity, regularity/rhythmicity, Bayley scores, fine motor play, and emotional expression.

The results of the cross-lagged panel analysis were disappointing, particularly as the study was specifically designed to permit application of this type of analysis. the basic problem appears to be the strong assumption of the method that the individual variables are stable, with similar test reliabilities across time (Crano, 1977). This study, however, appears to be examining relationships where some variables are stable, but others change with the age of the infant, changing the nature of the relationships involved. This limits the strength of the conclusions which can be made. Moreover, it does not seem to be a problem

peculiar to this particular research; it is doubtful if many studies of infant social development result in factorially consistent findings. Cross-lagged panel analysis has been applied in these situations (eg. Clarke-Stewart, 1973), however it seems that results must be interpreted with a great deal of caution.

The major inference from the cross-lagged panel analyses concerns the relationship between rated infant activity level and maternal behaviour. Between 3 and 9 months, the relationship of the activity ratings to measures of maternal involvement changes from one which is negative (low activity associated with high involvement) to one which is positive (high activity and high involvement). Even in light of the cautions stated, there are a number of consistent indications in the data which point to the mother as the major agent of change in the relationship. Primarily, these include the relative size of the cross-lagged correlations and the stability of the maternal variables over time. The most likely hypothesis, overall, from the analyses seems to be that high maternal involvement at 3 and perhaps 6 months of age tends to lead to higher infant activity at 9 months. (Or, conversely, low involvement leads to low activity levels.)

For the other temperament trait ratings, relationships with maternal behaviours are much less consistent than those for activity. Even in these, however, there appears to be a consistent trend toward support for hypotheses indicating

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that maternal behaviour alters infant temperament ratings rather than vice versa.

One problem with these conclusions concerns the validity of the Carey scale used to assess temperament. In the case of activity, at least at younger ages, this is questionable. At 9 months, ratings of activity do seem to have some construct validity, inasmuch as they correlate with a number of other theoretically related ratings. At 3 months, however, there appears to be little relationship between mothers' ratings of their infants' activity levels and any of the other infant variables. Instead, these ratings are most related to (low) maternal involvement. The 6 months ratings have more relationship to other theoretically related variables, but it is only at 9 months that ratings of activity seem to have much construct validity, correlating with a number of other theoretically related measures.

It appears, then, that the mothers' ratings of activity at early ages may tap a different dimension of activity than that revealed in the other measures. There are two plausible explanations for this finding. The first is that, by focussing so directly on mother-oriented situations, Carey's scale is measuring only a part of the concept of 'activity' and that this aspect at 3 months is relatively unrelated to other measures, although it becomes more related with increasing age. The second explanation is that the scales are simply not valid for use at the earlier ages, perhaps

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because the items are less relevant for very young infants whose scope of movement is restricted by both opportunity and ability. Obviously, this is a question which requires more information and further research.

The hierarchical grouping analysis does shed some additional light on the issue of the relationship of perceived activity levels to maternal behaviour. This analysis divided the infants into three profile groups, the first with consistently high activity ratings (H-H-H), the second with low, then high ratings (L-H-H), and the last with a high-moderate-high pattern (H-M-H). Analysis of the maternal behaviour indices for these three groups seemes to indicate a slight tendency for mothers in the different groups to behave differently towards their infants, the difference being most pronounced between the H-M-H group and groups H-H-H and L-H-H. At 6 months, particularly, those infants with the H-M-H rating pattern received more physical contact, more overall involvement, and more visual attention from their mothers than the other infants.

What is indicated, then, is a relationship between the infants' activity level as perceived and rated by the mother and the amount of attention which the mother directs toward the infant. This relationship appears to vary both with the age of the infant, and with the pattern of change over time. Although the direction of the causal relationship is somewhat unclear, some case can be made for the efficacy of the mother's actions, with attention during the first half

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of the first year resulting in higher levels of activity later on. Obviously, this hypothesis needs to be investigated by further research.

VI. Speculations and Implications

As with most research, there are a number of factors involved in this study which limit the certainty with which conclusions can be drawn. Primary among these factors here are the small sample size relative to the number of variables included, and the changing size and direction of concurrent correlations, which caused difficulties in the application of the cross-lagged panel analysis.

In spite of these limitations, however, the results of the study seem to have implications for a number of topic areas in developmental psychology, particularly in regard to the theory and application of concepts of temperament.

A. Implications for the Theory of Temperament:

A number of the findings of this study pertain to the theoretical model of temperament put forward by Thomas, Chess and Birch (1968). These authors defined the nine temperament categories applied by Carey in the development of his questionnaire. In addition, they have suggested the use of two temperament 'types' involving particular clusters of characteristics. The first of these is an 'easiness' dimension defined in terms of high rhythmicity, approach, and adaptability, positive mood, and moderate intensity. (The other pole, 'difficulty', is defined by the opposite characteristics.) The second cluster is called 'slow-to-

warm-up', and is defined by low approach, adaptability, intensity and mood.

Evidence for these patterns in this study is mixed. There does seem to be a persistent clustering of the three traits of adaptability, approach and mood. These are stable across time and load consistently on a single factor in each of the factor analyses. They appear to form the core of an 'easiness' dimension for these 3 to 10 month old infants. Of the other traits included in the original definition, however, rhythmicity is included on the same factor in only one analysis, and then only at 3 months. Similarly, intensity is included only at 6 months. On the other hand distractability and threshold were not included in the original definition, but also have occasional loadings on the 'easiness' factors here.

While there appears to be support here for some form of an 'easiness' temperament dimension, there is none for the proposed 'slow-to-warm-up' cluster. This set of traits does not appear as a unit in any of the analyses. Nor did this cluster appear in the factor analyses done by Thomas, Chess and Birch (1968), or Scholom (1975).

Thus, this research provides some support for Thomas, Chess and Birch's proposed temperament dimension of 'easiness/difficulty', but none for that of ease of acceptance of change. Two major differences between this and the original research must, however, be taken into account when interpreting these findings. The original

classifications were done with older children (using retrospective records), and they were based on very extensive interviews rather than brief questionnaires. There is some possibility that they may be valid for older children, where the range of behaviour is less restricted than in infancy. Again, a need for further research is apparent.

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APPENDIX A

OBSERVATION CODING CATEGORIES AND RATING SCALES

APPENDIX A

OBSERVATION CODING CATEGORIES

(Adapted from Lytton, Undated)

Behaviour Codes

I. Subject/Object:

M - mother
C - child
D - father
A - other adult
I - item
O - observer
F - food
T - toy
P - pet
B - baby

II. Behavioural Predicates:

Physical Acts:
01 - Holds
02 - Goes (toward)
03 - Physical stimulation (what)
04 - Touches
05 - Restrains physically
06 - Physical punishment
07 - Gives (what)
08 - Drops (what)
09 - Takes (what)
10 - Hurts, becomes distressed
11 - Play, gross motor (with)
12 - Play, fine motor (with)
13 - Mouths (what)
14 - Shows (what)
15 - Puts (what)
16 - Holds on shoulder
17 - Sleeps
18 - Reaches (what)

Miscellaneous:
50 - Housework
51 - Reads
52 - Sings
53 - Watches T.V.
54 - Hobbies
55 - Telephone Conversation

Social Acts:
20 - Smiles, shows pleasure
21 - Looks (at)
22 - Calls, vocal demand
23 - Non-vocal request, demand (to)
24 - Vocalizes, social speech (to)
25 - Referential speech (labelling, giving information) (to)
26 - Praises (who)
27 - Vocal punishment, reprimand, no
28 - Cries, fusses
29 - Non-vocal Communication
30 - Non-compliance

Caretaking Acts:
40 - Feeds liquids (to)
41 - Feeds solids (to)
42 - Eats (what)
43 - Changes
44 - Washes, wipes, combs, checks
45 - Dresses
46 - Burps

V. Adverbs describing behaviours:

1 - Playfully
2 - With irritation, anger
3 - Quietly, gently, showing affection
4 - With intensity
5 - Quickly
6 - Slowly, with reluctance
7 - Imitatively
8 - Comfortingly
9 - Abstractedly

VI. Supplementary information:

V - with vocalization (=24)
S - with smile, pleasure (=20)
N - non-compliance (deliberate non-response to demand)

Setting Codes

I. Setting alert - Z

II. Location:

1 - Living, family room
2 - Kitchen
3 - Bathroom
4 - Child's bedroom
5 - Other bedroom
6 - Other room in home
7 - Outside
8 - Bath

III. Child position:

1 - on floor, unconstrained
2 - on table, other surface
3 - mother holding
4 - in walker
5 - in play-pen
6 - infant chair or highchair
7 - Jolly Jumper
8 - bed, crib

IV. Who present:

C - child out of sight of mother
M - mother and child in visual contact (or contact possible)

V. Background Sound:

1 - T.V.
2 - Radio
3 - Records
4 - Musical Toy

VI. Other people present:

C - other child
F - father
A - other adult
P - father and other

INFANT-MOTHER RATING SCALES
(Clarke-Stewart, 1973)

I. Infant's Activity Level:

Passive, inactive 0 1 2 3 4 Very Active

II. Mother's Positive Emotional Involvement with Baby:

A. Tone of Voice

Angry, hostile	Distant, cold	Unemotional, Neutral	Lukewarm	Warm, kind	Very warm lovey
-2	-1	0	+1	+2	+3

B. Amount of expressed positive emotion

None 0 1 2 3 4 Very much

III. Mother's Attitude toward Child's Behaviour:

Unaccepting 0 1 2 3 4 Completely accepting

IV. Mother's Skill in Caretaking:

Inefficient 0 1 2 3 4 Super efficient

V. Amount and Kind of Contact with Mother:

A. Physical

Amount:	Never	0	1	2	3	4	Very frequent
Closeness:	Distant	0	1	2	3	4	Close
Vigor:	Passive	0	1	2	3	4	Vigorous

B. Auditory-verbal

Amount: Never 0 1 2 3 4 Very frequent

C. Visual, eye-to-eye

Amount: Never 0 1 2 3 4 Very frequent

D. With materials

Amount: Never 0 1 2 3 4 Very frequent

E. Social stimulation

Amount: Never 0 1 2 3 4 Very frequent

F. Communicative stimulation (referential)

Amount: Never 0 1 2 3 4 Very frequent

VI. Responsiveness of Mother to Child's Behaviour:

A. Frequency

To distress:	Never	0	1	2	3	4	Always
To social expressions:	Never	0	1	2	3	4	Always
To demands:	Never	0	1	2	3	4	Always
To physical need:	Never	0	1	2	3	4	Always

B. Latency

Very slow	0	1	2	3	4	Immediate

VII. Appropriateness of Mother's Behaviour:

A. Effectiveness

Never	0	1	2	3	4	Always

B. For age and ability of child

Never	0	1	2	3	4	Always

VIII. Responsiveness of Child to Mother's Behaviour:

A. Frequency

To social expressions:	Never	0	1	2	3	4	Always

b. Latency

Very slow	0	1	2	3	4	Immediate

APPENDIX B

CAREY SURVEY OF INFANT TEMPERAMENT CHARACTERISTICS

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CAREY SURVEY OF INFANT TEMPERAMENT CHARACTERISTICS

The following questions concern your baby's reactions to various activities and events. Circle the letter of the alternative which best describes your baby at this time. Some of the questions may be difficult to answer, but do the best you can. If the question refers to a situation which has never yet occurred (for example, illness), leave it out. Also, if you are breast-feeding your infant, you may need to estimate quantity of milk taken.

SLEEP

1. (a) Generally goes to sleep at about the same time for night and naps (within ½ hour).
   (b) Partly the same times, partly not.
   (c) No regular pattern. Times vary 1 - 2 hours or more.

2. (a) Generally wakes up at about same time from night and naps.
   (b) Partly the same times, partly not.
   (c) No regular pattern. Times vary 1 - 2 hours or more.

3. (a) Generally happy (smiling, etc.) on waking up and going to sleep.
   (b) Variable mood at these times.
   (c) Generally fussy on waking up and going to sleep.

4. (a) Moves about crib much (such as from one end to the other during sleep.
   (b) Moves a little (a few inches).
   (c) Lies fairly still. Usually in same position when awakens.

5. With change in time, place or state of health:
   (a) Adjusts easily and sleeps fairly well within 1-2 days.
   (b) Variable pattern.
   (c) Bothered considerably. Takes at least 3 days to readjust sleeping routine.

FEEDING

6. (a) Generally takes milk at about same time. Not over 1 hour variation.
   (b) Sometimes same, sometimes different times.
   (c) Hungry times unpredictable.

7. (a) Generally takes about the same amount of milk, not over 2 oz. difference.
   (b) Sometimes same, sometimes different amounts.
   (c) Amounts taken unpredictable.

8. (a) Easily distracted from milk feedings by noises, changes in place, or routine.
   (b) Sometimes distracted, sometimes not.
   (c) Usually goes on sucking in spite of distractions.

9. (a) Easily adjusts to parents' efforts to change feeding schedule within 1 - 2 tries.
   (b) Slowly (after several tries) or variable.
   (c) Adjusts not at all to such changes after several tries.

10. (a) If hungry and wants milk, will keep refusing substitutes (solids, water, pacifier) for many minutes.
    (b) Intermediate or variable.
    (c) Gives up within a few minutes and takes what is offered.

11. (a) With interruptions of milk or solid feedings, as for burping, is generally happy, smiles.
    (b) Variable response.
    (c) Generally cries with these interruptions.

12. (a) Always notices (and reacts to) change in temperature or type of milk or substitutions of juice or water.
    (b) Variable.
    (c) Rarely seems to notice (and react to) such changes.

13. (a) Suck generally vigorous.
    (b) Intermediate.
    (c) Suck generally mild and intermittent.

14. (a) Activity during feedings--constant squirming, kicking, etc.
    (b) Some motion: intermediate.
    (c) Lies quietly throughout.

15. (a) Always cries loudly when hungry.
    (b) Cries somewhat but only occasionally hard or for many minutes.
    (c) Usually just whimpers when hungry, but doesn't cry loudly.

16. (a) Hunger cry usually stopped for at least a minute by picking up, pacifer, putting on bib, etc.
    (b) Sometimes can be distracted when hungry.
    (c) Nothing stops hunger cry.

17. (a) After feeding, baby smiles and laughs.
    (b) Content but not usually happy (smiles, etc.) or fussy.
    (c) Fussy and wants to be left alone.

18. (a) When full, clamps mouth closed, spits out food or milk, bats at spoon, etc.
    (b) Variable.
    (c) Just turns head away or lets food drool out of mouth.

19. (a) Initial reaction to new foods (solids, juice, vitamins) acceptance. Swallows them promptly without fussing.
(b) Variable response.
(c) Usually rejects new foods. Makes face, spits out, etc.

20. (a) Initial reaction to new foods pleasant (smiles, etc.) whether accepts or not.
(b) Variable or intermediate.
(c) Response unpleasant (cries, etc.) whether accepts or not.

21. (a) This response is dramatic whether accepting (smacks lips, laughs, squeal) or not (cries).
(b) Variable.
(c) This response mild whether accepting or not. Just smiles, makes face or no expression.

22. (a) After several feedings of any new food, accepts it.
(b) Accepts some, not others.
(c) Continues to reject most new foods after several tries.

23. (a) With changes in amounts, kinds, timing of solids does not seem to mind.
(b) Variable response. Sometimes accepts, sometimes not.
(c) Does not accept these changes readily.

24. (a) Easily notices and reacts to differences in taste and consistency.
(b) Variable.
(c) Seems seldom to notice or react to these differences.

25. (a) If does not get type of solid food desired, keeps crying till gets it.
(b) Variable.
(c) May fuss briefly, but soon gives up and takes what offered.

SOILING AND WETTING

26. (a) When having bowel movement, generally cries.
(b) Sometimes cries.
(c) Rarely cries though face may become red. Generally happy (smiles, etc.) in spite of having bowel movement (b.m.).

27. (a) Bowel movements generally at same time of day (usually within 1 hour of same time).
(b) Sometimes at same time, sometimes not.
(c) No pattern. Usually not same time.

28. (a) Generally indicates in some that is soiled with b.m.
(b) Sometimes indicates.
(c) Seldom or never indicates.

29. (a) Usually fusses when diaper soiled with b.m.
(b) Sometimes fusses.
(c) Usually does not fuss.

30. (a) Generally indicates that is wet (no b.m.).
(b) Sometimes indicates.
(c) Seldom or never indicates.

31. (a) Usually fusses when diaper wet (no b.m.).
(b) Sometimes fusses.
(c) Usually does not fuss.

32. (a) When fussing about diaper, does so loudly. A real cry.
(b) Variable.
(c) Usually just a little whimpering.

33. (a) If fussing about diaper, can easily be distracted for at least a few minutes by being picked up, etc.
(b) Variable.
(c) Nothing distracts baby from fussing.
(d) Does not fuss.

DIAPERING AND DRESSING

34. (a) Squirms and kicks much at these times.
(b) Moves some.
(c) Generally lies still during these procedures.

35. (a) Generally pleasant (smiles, etc.) during diapering and dressing.
(b) Variable.
(c) Generally fussy during these times.

36. (a) These feelings usually intense: vigorous laughing or crying.
(b) Variable.
(c) Mildly expressed usually. Little smiling or fussing.

BATHING

37. (a) Usual reaction to bath: smiles or laughs.
(b) Variable or neutral
(c) Usually cries or fusses.

38. (a) Like or dislike of bath is intense, excited.
(b) Variable or intermediate.
(c) Like or dislike is mild, not excited.

39. (a) Kicks, splashes and wiggles throughout.
(b) Intermediate--moves moderate amount.
(c) Lies quietly or moves little.

40. (a) Reaction to very first tub (or basin) bath. Seemed to accept it right away.
    (c) At first protested against bath.

41. (a) If protested at first, accepted it after 2 or 3 times.
    (b) Sometimes accepted, sometimes not.
    (c) Continued to object even after two weeks.

42. (a) If bath by different person or in different place, readily accepts change first or second time.
    (b) May or may not accept it.
    (c) Objects consistently to such changes.

PROCEDURES--NAIL CUTTING, HAIR BRUSHING, WASHING FACE AND HAIR, MEDICINES

43. (a) Initial reaction to any new procedure: generally acceptance.
    (b) Variable.
    (c) Generally objects; fusses or cries.

44. (a) If initial objection, accepts after 2 - 3 times.
    (b) Variable acceptance. Sometimes does, sometimes does not.
    (c) Continues to object even after several times.

45. (a) Generally pleasant during procedures once established--smiles, etc.
    (b) Neutral or variable.
    (c) Generally fussy or crying during procedures.

46. (a) If fussy with procedures, easily distracted by game, toy, singing, etc., and stops fussing.
    (b) Variable response to distraction.
    (c) Not distracted. Goes on fussing.

VISITS TO DOCTOR

47. (a) With physical exam, when well, generally friendly and smiles.
    (b) Both smiles and fusses: variable.
    (c) Fusses most of the time.

48. (a) With shots cries loudly for several minutes or more.
    (b) Variable.
    (c) Cry over in less than a minute.

49. (a) When crying from shot, easily distracted by milk, pacifer, etc.
    (b) Sometimes distracted, sometimes not.
    (c) Goes right on crying, no matter what is done.

RESPONSE TO ILLNESS

50. (a) With any kind of illness, much crying and fussing.
    (b) Variable.
    (c) Not much crying with illnesses. Just whimpering sometimes. Generally his usual self.

SENSORY--REACTIONS TO SOUNDS, LIGHT, TOUCH.

51. (a) Reacts little or not at all to unusual loud sound or bright light.
    (b) Intermediate or variable.
    (c) Reacts to almost any change in sound or light.

52. (a) This reaction to light or sound is intense--startles or cries loudly.
    (b) Intermediate--sometimes does, sometimes not.
    (c) Mild reaction--little or no crying.

53. (a) On repeated exposure to these same lights or sounds, does not react so much any more.
    (b) Variable.
    (c) No change from initial negative reaction.

54. (a) If already crying about something else, light or sound makes crying stop briefly at least.
    (b) Variable response.
    (c) Makes no difference.

RESPONSES TO PEOPLE

55. (a) Definitely notices and reacts to differences in people: age, sex, glasses, hats, or other physical differences.
    (b) Variable reaction to differences.
    (c) Similar reactions to most people unless strangers.

56. (a) Initial reaction to approach by strangers positive, friendly (smiles, etc.).
    (b) Variable reaction.
    (c) Initial rejection or withdrawal.

57. (a) This initial reaction to strangers is intense: crying or laughing.
    (b) Variable.
    (c) Mild--frown or smile.

58. (a) General reaction to familiar people is friendly--smiles, laughs.
    (b) Variable reaction.
    (c) Generally glum or unfriendly. Little smiling.

59. (a) This reaction to familiar people is intense--crying or laughing.
    (b) Variable.
    (c) Mild--frown or smile.

REACTION TO NEW PLACES AND SITUATIONS

60. (a) Initial reaction acceptance--tolerates or enjoys them within a few minutes.
    (b) Variable.
    (c) Initial reaction rejection--does not tolerate or enjoy them within a few minutes.

61. (a) After continued exposure (several minutes) accepts these changes easily.
    (b) Variable.
    (c) Even after continued exposure, accepts changes poorly.

PLAY

62. (a) In crib or play pen can amuse self for half-hour or more looking at mobile.
    (b) Amuses self for variable length of time.
    (c) Indicates need for attention or new occupation after several minutes.

63. (a) Takes new toy right away and plays with it.
    (b) Variable.
    (c) Rejects new toy when first presented.

64. (a) If rejects at first, after short while (several minutes) accepts new toy.
    (b) Variable.
    (c) Adjusts slowly to new toy.

65. (a) Play activity involves much movement--kicking, waving arms, etc. Much exploring.
    (b) Intermediate.
    (c) Generally lies quietly while playing. Explores little.

66. (a) If reaching for toy out of reach, keeps trying for 2 minutes or more.
    (b) Variable.
    (c) Stops trying in less than ½ minute.

67. (a) When given a toy, plays with it for many minutes.
    (b) Variable.
    (c) Plays with one toy for only short time (only 1 - 2 minutes).

68. (a) When playing with one toy, easily distracted by another.
    (b) Variable.
    (c) Not easily distracted by another toy.

69. (a) Play usually accompanied by laughing, smiling, etc.
    (b) Variable or intermediate.
    (c) Generally fussy during play.

70. (a) Play is intense: much activity, vocalization or laughing.
(b) Variable or intermediate.
(c) Plays quietly and calmly.

Temperament Questionnaire--Scoring Sheet
(x = no score; * = score in two categories).
The responses on the questionnaire are transposed to this
score sheet providing a total score of high, medium or low for each dimension of temperament.

	Activity			Rhythmicity			Adaptability			Approach			Threshold			Intensity			Mood			Distractability			Persistence		
	H	M	L	R	V	I	A	V	N	A	V	W	H	M	L	I	V	M	P	V	N	D	V	N	P	V	N
0:	4			1			5												3			8					
	a	b	c	a	b	c	a	b	c										a	b	c	a	b	c			
				2			9																				
				a	b	c	a	b	c																		
				6																							
				a	b	c																					
				7																							
				a	b	c																					
10:	13									19			12			15			11			16			10		
	a	b	c							a	b	c	c	b	a	a	b	c	a	b	c	a	b	c	a	b	c
	14															18			17								
	a	b	c													a	b	c	a	b	c						
20:				27			22						24			21			20						25		
				a	b	c	a	b	c				c	b	a	a	b	c	a	b	c				a	b	c
							23						28			26*			26*								
							a	b	c				c	b	a	a	b	c	c	b	a						
																			29								
																			x	b	a						
30:	31						35*						30			32			31			33					
	a	b	c				a	b	c				c	b	a	a	b	c	x	b	a	a	b	c			
	39															36			35*								
	a	b	c													a	b	c	a	b	c						
																38			37								
																a	b	c	a	b	c						

Temperament Questionnaire--Scoring Sheet (Continued)

	Activity			Rhythmicity			Adaptability			Approach			Threshold			Intensity			Mood			Distractability			Persistence		
	H	M	L	R	V	I	A	V	N	A	V	W	H	M	L	I	V	M	P	V	N	D	V	N	P	V	N
40:							41			40			42*			48			45			46					
							a	b	c	a	x	c	a	b	c	a	b	c	a	b	c	a	b	c			
							42*			43									47*			49					
							a	b	c	a	b	c							a	b	c	a	b	c			
							44																				
							a	b	c																		
							47*																				
							a	b	c																		
50:							53			56*			51			52			50			54					
							a	b	c	a	b	c	a	b	c	a	b	c	c	b	a	a	b	c			
													55			57			56*								
													c	b	a	a	b	c	a	b	c						
																59			58								
																a	b	c	a	b	c						
60:	65						61			60*									60*						62		
	a	b	c				a	b	c	a	b	c							a	b	c				a	b	c
							64			63									69			68			66		
							a	b	c	a	b	c							a	b	c	a	b	c	a	b	c
																70									67		
																a	b	c							a	b	c
TOTAL																											

APPENDIX C

PARENT INFORMATION QUESTIONNAIRE

AND

SUMMARY OF RESPONSES

APPENDIX C

PARENT INFORMATION QUESTIONNAIRE

Parents' Name: _____

Address: _____

Child's Name _____ Birthdate: _____

1. Original method of feeding: _____

2. Date of Weaning: Breast: _____ Bottle: _____

3. Have you cared for infants before?

   Extensively Some Very Little Not at all

4. How much reading have you done concerning infant or child development and care?

   None Very Little Some A Great Deal

5. Do you own any books on infant/child development and care?

   Yes No

   If yes, how many? 1 2 3 4 5 More than 5

6. Other sources of information: To what extent have you consulted the following:

   Grandparents: _____

   Friends: _____

   Public Health Nurses: _____

   Courses: _____

   Other: _____

1. How much education have you and your husband had?

	Mother	Father
Less than 8 years	_____	_____
8 - 12 years	_____	_____
13 - 16 years	_____	_____
More than 16 years	_____	_____

2. What is (or was) your occupation?

_____

3. What is your husband's occupation?

_____

4. What is your religious affiliation?

_____

Summary of Responses

1. Original Feeding Method: Breast - 28 (93.3%)
   Bottle - 2 (6.7%)

2. Age at Weaning: (from breast)
   <3 Mos. - 6 (20.0%)
   <6 Mos. - 8 (26.7%)
   <9 Mos. - 5 (16.7%)
   ≥9 Mos. -11 (36.7%)

3. Cared for Infants Before:
   Extensively - 7 (23.3%)
   Some - 7 (23.3%)
   Very Little - 7 (23.3%)
   Not at All - 9 (30.0%)

4. Reading About Infancy:
   Great Deal -15 (50.0%)
   Some -13 (43.3%)
   Very Little - 2 (6.7%)
   None - 0 (0.0%)

5. Own Books: Yes - 27 (90.0%) (Average No. = 3.2)
   No - 3 (10.0%)

6. Education Levels:

	Mother	Father
< 8 yrs.	0 (0.0%)	0 (0.0%)
8 - 12 yrs.	10 (33.3%)	8 (26.7%)
13 - 16 yrs.	13 (43.3%)	8 (26.7%)
> 16 yrs.	7 (23.3%)	14 (46.6%)

7. Occupation Levels. (Using Blishen Occupational Index, 1967)

Category	Mother	Father
71-80	1 (3.3%)	6 (20.0%)
61-70	9 (30.0%)	5 (16.7%)
51-60	3 (10.0%)	4 (13.3%)
41-50	4 (13.3%)	7 (23.3%)
31-40	10 (33.3%)	4 (13.3%)
0-30	1 (3.3%)	3 (10.0%)
Student or Housewife	2 (6.6%)	1 (3.3%)

8. Religious Affiliation:
   Protestant - 33 (55.0%)
   Catholic - 20 (33.3%)
   Other - 7 (11.7%)

APPENDIX D

CORRELATION MATRICES

TAELE 1

Correlations Between Infant Activity Ratings and Maternal Behaviors[1]

		M Involv. C			M Smiles C			M Looks C			M Voc. C			M Rep. C			Caretaking			M-C Contact			Mutual Looking		
		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
Activity	T1	35	-11	15	15	-13	11	25	-07	12	01	-03	19	07	01	25	19	-23	15	37	-28	45	06	-14	-10
	T2	00	-19	-14	-09	-17	-03	-05	-21	-11	-29	-32	-23	25	15	37	05	03	11	-11	-14	-05	-17	-14	-30
	T3	-29	-50	-47	-11	-21	07	-37	-53	-45	-31	-36	-32	01	-22	00	-09	-11	-02	-39	-36	-20	-22	-21	-38
Rhythmicity	T1	-14	04	-04	00	15	05	-20	06	00	-20	-11	-19	18	-25	-21	-08	03	02	-07	01		-04	-05	-24
	T2	01	32	33	09	30	09	13	32	35	19	20	16	16	-23	-15	07	26	19	05	04	11	28	15	04
	T3	-15	32	-01	-05	20	03	06	24	-01	30	39	17	18	-06	-08	-25	19	07	-28	29	01	44	16	-14
Adaptability	T1	-07	-20	-02	-06	-09	-14	-20	-18	-04	-18	-12	-07	23	-05	00	12	-29	-30	17	-15	02	-13	-12	00
	T2	04	-03	26	-06	06	04	-02	-03	25	04	-05	03	-10	-14	00	07	-09	-09	08	-29	21	-05	-06	23
	T3	-02	02	15	-07	07	19	04	-01	12	21	12	16	-13	15	17	-03	-09	-28	-11	-20	20	06	-07	14
Approach	T1	28	33	42	05	31	09	20	39	43	03	12	04	32	18	23	40	-06	-15	31	14	43	12	09	15
	T2	11	14	35	-27	23	08	09	21	38	-13	02	-03	18	00	22	28	-17	-17	09	-03	42	-08	-01	09
	T3	07	19	39	-10	23	23	13	24	38	18	11	21	16	17	24	02	-23	-24	04	-14	39	09	06	26
Threshold	T1	-10	01	12	00	05	-15	-13	07	14	10	11	13	-09	00	21	-13	-24	-10	-01	-06	-09	-09	-14	04
	T2	-11	-07	05	-12	01	-11	-14	-06	05	-31	-18	-16	15	23	37	08	-01	-10	-08	18	-02	-36	-12	-15
	T3	-14	-04	05	-08	-24	-11	-17	-04	08	-31	-17	-12	-02	51	36	05	01	10	-10	06	-18	-26	-03	05
Intensity	T1	05	-09	-01	-01	-04	-02	07	-08	-03	04	-02	11	16	-18	13	-12	-10	-04	00	-13	22	-06	01	-13
	T2	17	01	-05	11	-06	35	08	04	-07	-07	-03	00	-27	-11	-09	-07	-06	07	-04	02	22	02	25	07
	T3	-07	-17	-21	-24	-18	02	01	-15	-20	-06	-12	-14	05	-30	-08	-23	-09	14	-26	-23	01	09	13	08
Mood	T1	-03	03	24	-07	21	-01	-02	07	27	-06	04	04	15	-05	-06	10	-11	-24	11	-02	15	-23	-14	10
	T2	-07	09	25	-15	11	-10	-08	07	28	-13	-06	-01	00	-13	06	-05	-01	-12	-07	03	26	-33	-10	03
	T3	01	14	31	08	27	19	04	10	29	13	13	22	11	16	05	21	18	-07	10	08	11	-23	16	21
Distractability	T1	01	-01	06	-03	-12	03	-05	00	06	-05	04	-11	-13	10	07	17	-01	-01	04	-17	15	22	05	18
	T2	-17	01	03	-01	-14	00	-16	02	03	-09	01	-04	-37	08	-12	-06	14	23	-13	-02	-03	00	22	45
	T3	04	06	17	05	02	21	11	06	15	12	17	15	-12	-13	28	-09	-05	-18	-07	-13	41	20	01	02
Persistence	T1	21	16	08	-13	-06	-10	24	16	09	38	33	23	22	04	32	12	03	09	-02	05	-06	25	12	-02
	T2	01	04	02	14	09	13	05	00	-07	30	34	29	-02	-23	-11	16	13	17	13	-06	05	33	21	05
	T3	-11	03	-09	02	27	12	-03	01	-12	26	18	10	14	-32	-25	-06	07	02	-12	13	00	-02	07	-10

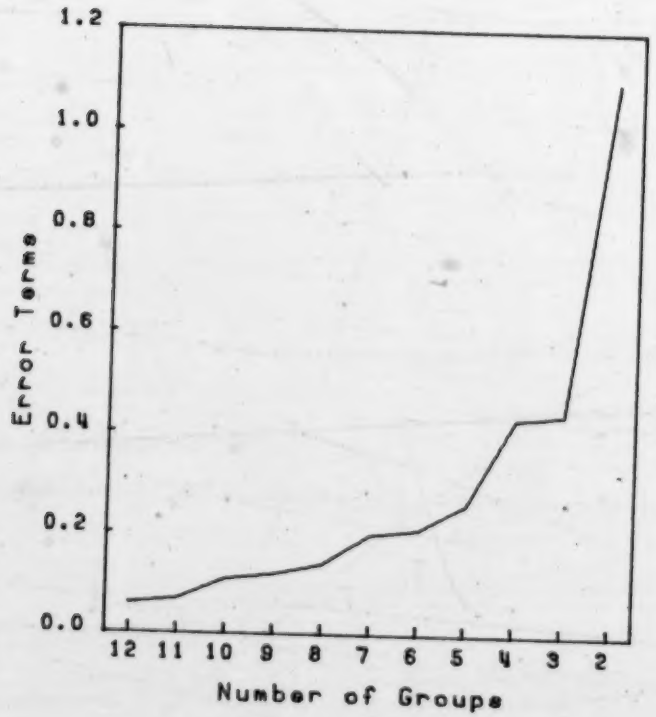
[1]Decimals omitted

TABLE 2

Cross Time Correlations for Mother and Infant Observation Variables and Bayley Scores

Variable	T1-T2	T2-T3	T1-T3
M Inv. C	.43	.73	.53
M Smiles C	.33	.51	.60
M Looks C	.60	.82	.63
M. Voc.	.65	.74	.66
M. Voc. C	.75	.77	.78
M. Rep. C	-.01	.52	.14
Caretaking	.22	.68	.25
M-C Contact	.17	.11	.44
C Inv. M	.38	.27	.15
C Smiles M	.04	.52	.18
C Looks M	.26	.47	-.03
C Fusses	.22	-.02	.24
C Toy Inv.	-.11	.06	.17
Gross Motor Play	.04	.29	.08
Fine Motor Play	.25	.57	.21
C-M Contact	.20	.12	.26
C Voc.	.50	.29	.09
C Voc. M	.54	.19	.19
Bayley Mental	.09	.62	.38
Bayley Motor	.44	.38	.03

APPENDIX E

ACTIVITY PROFILE GROUPS: ERROR TERMS

ACTIVITY PROFILE GROUPS: ERROR TERMS